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Digitizing the Dead: Understanding ‘Data Hauntings’ to Support Equitable Data Work with Human Remains

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Abstract

Thousands of human remains are stored in museums and collections worldwide. But while their collection, handling and display are increasingly subjected to ethical guidelines and regulations, institutional guidelines and research on their digitization are scarce. This study explores the challenges and opportunities of digitizing human remains, outlining new directions. Based on interviews (n=23) with museum professionals across 14 organizations worldwide, we map: 1) A taxonomy of data work with human remains; 2) Main areas of uncertainties in data work and adaptive strategies currently employed to address them; 3) Examples of ill-fitting digital systems. We introduce the concept of ‘data hauntings’ to highlight the historical, technical and regulatory ghosts lingering in digital systems of contested assets, and the specters of future data circulation. Lastly, we propose a ‘hauntological’ framework for rethinking, (re)designing and maintaining digital systems to enable equitable data work - balancing historical trace-ability, ethical accountability and searchability.

CCS Concepts

• **Human-centered computing**; • **Human-computer interaction (HCI)**; • **Empirical studies in HCI**;

Keywords

Death, CMS, data work, human remains

ACM Reference Format:

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1 Introduction

Thousands of human remains are stored in scientific collections and museums around the world – from skeletal remains and mummified bodies, to anatomical preservations of organs and fetuses in glass

jars. Over time, as these dead bodies have shifted from subjects to historical objects within many disciplinary settings [1], they carry with them sedimented layers of outdated classification systems and legacies of potentially problematic practices. For the most part, they have been sourced in conditions of power inequality and lack of consent [37, 44, 70]. Due to the contested legacies of human remains, debates on their stewardship are regularly ignited by the press [8, 72] and a growing body of research discusses how to ethically care for them [20, 22, 34, 58].

But if the physical collection, display, management, reburial and repatriation of the dead are typically governed by institutional policies and ethical guidelines, their digital life has received less attention and is a topic that is wide open for exploration and debate. Studies on the digitization of historical human remains are still very few [52, 53, 77], and despite some recent institutional and disciplinary guidelines (see Background), there are no broadly accepted guidelines for professionals across disciplines, including digitization [53].

With this study, we fill this research gap and contribute to the growing body of HCI and CSCW research on data work [11, 19, 65, 69, 86] by exploring the complexities of digitizing human remains. Understanding data work with human remains is essential if we want to design and maintain digital ecosystems that support the needs of professional users in museums and scientific collections, while at the same time addressing the complex and pressing ethical questions that these collections are marked by. We refer to digitization as the ongoing process of creating and maintaining digital records in Collection Management Systems (CMS) and other digital tools, including spreadsheets, generating various forms of digital data. We focus specifically on internal digital systems, which might or might not be linked with online collections. By studying the relatively overlooked ‘back-end’ work of museums and collections we explore uncertainties and frictions that are mostly left unseen. As such, we also contribute to scholarship of HCI in museums and critical heritage studies [5, 21, 48] by expanding beyond visitor-facing technologies; and to research in critical computing by critically examining how digital systems are embedded in systems of power and fundamentally frictional [6, 12, 18, 30, 51, 67, 79, 92], identifying opportunities to support more ethical and equitable data practices.

1.1 Digitizing with ghosts

Given the complex temporality of digitizing human remains, we take an historicist approach, contextualizing digital systems within



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dynamic processes of “emergence, change, continuity, decline, disappearance, or revival” [78:459:4]. Creating and maintaining digital archives, including those of human remains, often means navigating the ghosts of colonialist pasts and other oppressive scientific practices, while trying to align with present and future organizational and user needs and perspectives [38, 88]. To explore how these ghosts shape data work we use the theoretical lens of *hauntology* [28] a philosophical approach that invites us to think and work with ghosts, reflecting on how injustices from the past still linger and haunt our institutions and digital systems today, and opening questions of accountability and equity. In this paper we look at *data work* as a sociotechnical process implying working actively and routinely with different forms of hauntings, with rich implications for policy and design.

We pursue the following research questions:

RQ1: What are the practices involved in the digitization of historical human remains?

RQ2: What are the challenges encountered in this data work, and how are they addressed?

RQ3: What opportunities are there to support equitable data work with human remains through design?

2 Background

2.1 Working with human remains and their data

We adopt the definition of human remains as “all matter originating from human tissue whether considered to be a part of an individual or defined as an object, part of, or intentionally or unintentionally included in objects (of art, craft, ritual artefact, or scientific artefacts), including bone, cremains, mummified tissue, hair, nails, skin, teeth, preparations of whole bodies, body parts and organs and other soft tissue, thin sections, and body fluids.” [66:1063]. We restrict our study’s scope to the digitization of historical human remains, and do not address contemporary collections developed with consent from body donation programs.

Stored in a variety of institutions - from museums to legacy anatomical collections in universities - historical human remains have been sourced from marginalized and disadvantaged communities [37, 44, 70] typically without consent. Dead bodies have been collected by doctors to perform research and develop medical theory and practice, as well as to be used as teaching material [43, 47]; and by archeologists, anthropologists and other scientists with a range of research agendas. This has also involved the study of people through socio-evolutionary systems based on racial and gender classifications - feeding into practices of economic and political exploitation and marginalization still persisting today [41]. For these and a host of other reasons, human remains in museums and research blur neat categorizations: they have been defined as *polysemic* (i.e. open to multiple interpretations) [1] and as *liminal categories*, as they are “simultaneously the material embodiment of a person, and biomaterial - situated between objects of science and lived lives” [66:1061]. In the field of medical museums, for instance, the dead body is a material remain of medical history [ibid] simultaneously a person, a scientific medical specimen and a cultural artifact, which generates intense debates on how human remains

should be displayed and cared for [89]. Since dead bodies in museums and research are legally liminal categories [66], ‘ownership’ of human remains is a blurry concept, and post-mortem body material in many countries is not legally owned by anyone, though historically some bodies (such as those of convicted criminals) became public property after death [76].

2.1.1 Ethical guidelines. This liminality has meant that clear guidelines on how to create and maintain digital records of human remains across disciplinary areas generally are lacking [53]. According to the Code of Ethics of the International Council of Museums (ICOM), human remains are considered ‘culturally sensitive material’ and should be treated with dignity and respect [49]. However, the document is vague as to how these principles should be implemented, since such mechanisms would have to match local socio-cultural understandings and policy. Many countries still lack clear ethical guidelines or regulations to support decision-making and professional practice [53]. In these cases, professionals refer to discipline-specific ethical guidelines, when available [16, 24, 31, 66]. Few countries have developed a comprehensive legislative approach. Notable examples of human remain laws are the UK Human Tissue Act, the New Zealand Human Tissue Act, the Australian Human Tissue Act and the Native American Graves Protection and Repatriation Act (NAGPRA) in the United States. Many collections and displays of human remains have been and are under scrutiny, particularly when related to eugenics, colonialism, scientific racism, or other outdated practices such as dissecting and preserving the bodies of patients from hospitals without their consent [22, 34, 58, 72]. Some museums have created participatory initiatives to publicly discuss questions related to stewardship, ownership and ethics, like the Postmortem project at Mütter Museum in Philadelphia and the Labelling Matters project at Pitt Rivers in Oxford. Ethical management of human remains is increasingly regulated by institutional policies that imply: 1) consultations and partnership with expert individuals or groups; 2) audit processes around provenance and sometimes consent; 3) processes of repatriation or reburial and, in some cases 4) concealing human remains from the public view, which also includes hiding photos of the remains in online collections [22, 27, 58, 89].

2.1.2 Human remains as digital records. There is thus a lot of uncertainty about what can be considered ethical treatment of human remains and their data. This variation is manifested widely globally and across disciplines - institutions in the same country might also have different approaches in the absence of national standards and laws. To date there is limited research on the digitization and digital management of human remains and their data. These studies have focused on the politics of public digital display [53]; the blurry ethics of 3D digitization of forensic and archeological human remains [77]; anthropological perspectives on the legacies of colonialist documentation practices in museums [88]; and issues related to using the FAIR (Findable, Accessible, Interoperable and Reusable) data management principles in bioarcheology [57]. These studies highlight many areas of uncertainty in the management of data around human remains, mainly due to a policy landscape in constant evolution and with several gaps; lack of literacy around issues related to equitable metadata practices and conflicting expectations around data shareability and privacy. All together, these

studies point to the need for more research on how scientific and cultural institutions currently address this, and how they can work towards better practices of data stewardship.

3 Related work and theoretical framework

The internal digital archives of museums and scientific collections are ecosystems in constant transformation [4, 50, 71]. Although they might appear from the outside as neutral and static repositories of data, they are collaborative and critical sites that enable both memory and forgetting [29, 30] and are crucial in shaping institutional knowledge-making practices. To examine the practical challenges implied in the digitization of human remains and to explore new opportunities for policy and design, we turn to HCI and CSCW research on *data work* (which we discuss in the next section) and illustrate the potential of ‘working with ghosts’ through the lens of *hauntology* (in section 3.2), bridging philosophy with critical computing.

3.1 Data work in HCI and CSCW and critical heritage

The digitization of human remains is a collaborative endeavor supported by *data work*, or “any human activity related to creating, collecting, managing, curating, analyzing, interpreting, and communicating data” [11:466]. HCI and CSCW research on the heritage domain has contributed to studying the sociotechnical infrastructure of museum collections using *representations* as a focal point – for instance how boundary objects and classification systems mediate understandings, embody certain worldviews, and shape coordination and power relationships [45, 56, 82]. However, there has been limited focus on data work in this domain. Although often overlapping with these conceptual understandings, the focal point of data work studies is human labor and its frictions, materialities and messy politics, which have been examined and conceptualized in a growing body of HCI and CSCW research in other data-driven infrastructures – such as healthcare [11, 69, 86], AI [2, 19, 93], advocacy [26], asylum case work [65] and citizen science [10]. All these studies are part of a broader ‘practice turn’ in HCI [55], shifting from ahistorical, technology-centered studies of interaction towards studies of emerging processes and practices situated in time and space. This body of research points to the many uncertainties emerging in data work, suggesting design opportunities for tools and workflows to support it [2]; shows the politics and frictions encoded in this work and the emerging practices that support accountability, care and equity [19, 65]; highlights how data work is ongoing, relational and subject to creative repurposing [26]; how data-driven systems are always supported by labor-intensive practices of data maintenance and repair [86]; and examines the wider institutional and organizational factors to better support digitization in collaborative, multi-layered ecosystems [69]. Most of these studies also examine the frictions and workarounds caused by rigid framings in the settings where data work takes place – whether arising from digital systems or institutional processes. As Dourish notes, “the materialities of database technologies shape the kind of “databasing” that can be done and imagined” [32:135] both limiting and opening up opportunities.

HCI studies on data work related to human remains are scarce. Doyle et al. have mapped bottlenecks in post-mortem data systems [33]. They highlight how incoherent policy, together with “a cultural aversion to engaging with death” [ibid], lead to inefficiencies in data ecosystems, and stress how taboos around death can disincentive broader efforts towards design solutions and policy making that target practical data work needs, complicating researchers’ access to data.

Digital anthropology scholarship conceptualizes digitization in museums as a cultural process of interpretation and meaning-making, and highlights the potential of the digital to remediate, recontextualize and reconnect [80]. Geismer proposes that digital CMS in museums could successfully convey alternative knowledge systems, while in practice their capacity “to be networked, hyper-linked and multisensorial is often obscured” [ibid:76]. Recent work in the humanities, particularly in decolonial studies, have focused on documentation work in museums, especially in relation to equitable ways to deal with colonial legacies [25, 36, 88]. This work examines the colonial logics encoded in museums’ histories and infrastructures – for instance in classification systems and in titles, captions and descriptions containing outdated offensive terms. This research calls for a ‘people-centered approach’ to equitable knowledge production based on a slow re-contextualization of museum records [25], that uses new tech for engagement and inclusion. However, this strand of work is less focused on comparative perspectives across different non-English speaking countries, and the practical aspects of different digital ecosystems in museums with limited staff/resources (such as university-based scientific collections). Legacies related to ableism or connected with themes of disability have been broadly overlooked.

We argue that a more explicit research focus on the practical, mundane challenges of data work experienced by the staff of museum and collections working with human remains can support the practical implementation and maintenance of more supportive and equitable digitization processes and ecosystems. In order to do so, we look at data work and digital archives of human remains through the lens of hauntology.

3.2 Hauntology

As discussed above, data work is supported by a system of analog and digital artefacts, which encode practices, values and assumptions *that are changing over time*. Museum databases and archives are often multi-layered and rich in sedimented knowledge and ideas as curators and researchers reorganize and add new objects and new data over time. This means that in some cases, as trans-media scholar Blackman suggests, digital archives can generate ‘haunted data’, putting back into circulation forgotten and past entities, actors and agencies, which travel beyond their original events and carry with them new affective and psychological dimensions [7]. Hauntology, upon which Blackman’s *haunted data* builds, is a concept first introduced by philosopher Jaques Derrida [28], a portmanteau of “ontology” (the study of being, of what is) and “haunting”. For Derrida, hauntology suggests a non-linear, recursive reading of time and history, a way of highlighting how the present is always intertwined with and fragmented by both the past and the future. How, in other words, immaterial specters

of the past – be they beings, ideas, memories or structures – and specters of possible futures linger in present ‘beings’ – or, in this case, digital databases and archives. Hauntology is thus a philosophical approach to thinking about how the past floats into and interrupts the present, which makes it seem uniquely suited to thinking about data work with digital archives, as they are both repositories of past ideas and epistemic tools for future work. For this paper, the connection between hauntology and data work is also strengthened by the strong connection of hauntology with questions of justice, as Derrida pointed out: “If I am getting ready to speak at length about ghosts, inheritance and generations, generations of ghosts (...) it is in the name of justice” [ibid:xix]. Similarly, for Barad hauntology is a form of response-ability: “To speak with ghosts, is (...) to take responsibility for that which we inherit (from the past and the future)” [3:264].

In sociology, hauntology has been used by Gordon as a lens for making sense of the legacies of colonialism and political repression – stressing how hauntings demand our attention, altering the way we separate and sequence the past, present and future [40]. In critical heritage studies it is conceptualized as a ‘critical-creative’ framework for investigating and addressing the problematic historical inheritances of museums [83]. Hauntology has also been embraced as a critical and transformative approach in feminist STS and media theory [3, 7, 62], postcolonial/decolonial studies [40, 74], as a lens to study health-related experiences and health technologies [80] and in environmental studies [90]. In HCI, ghosts can serve as a generative design resource [17], aligning with approaches that highlight the productive potential of ambiguity [35]. Patil et al. framed AI as a historical technology haunted by the specters of *coloniality* (i.e. the unequal structural power relations that emerged from colonial regimes and still persist) [68], reflecting on how “absence, spectrality and uncertainty can be used as phenomena and design materials for speculating on future imaginaries” [68:57]. Doing hauntological analysis enables researchers to capture the layered temporalities and ethical ambiguities of sociotechnical systems, to envision more accountable and equitable futures. Hauntology is also “a way of referring to the irreducible ontological ambiguity of the dead, their absent presence, and their present absence” [73:416–17], therefore a fitting lens for studying the challenges and opportunities of digitizing human remains, as staff deal simultaneously with ghosts of the past, and navigate present and future questions of accountability and ethics – while dealing with fluid entities that refuse clear categorizations.

4 Methodology

4.1 Participants and data collection

To answer our RQs, we conducted a qualitative study based on semi-structured interviews with 23 professionals working in 14 high-profile museums and legacy anatomical collections worldwide and 1 software company specialized in CMS for museums. The participants are based in 7 countries across 4 continents: Denmark (11 participants in 7 organizations); the UK (4 participants in 3 orgs); South Africa (3 participants in 1 org); Norway (2 participants in 1 org); Sweden (1 participant in 1 org); the USA (1 participant in 1 org) and New Zealand (1 participant in one org). At the time of the

interviews, all participants except for one (a retired museum director) were actively employed. The types of museums and collections represented in this study are: medical museums (6 institutions); university-based legacy anatomical collections, which includes historical forensic collections (5 institutions); ethnographic/historical museums (2 institutions), and 1 natural history museum. The staff members of the institutions involved in the study actively work with digital archives as part of their position and held the following positions (which were often combined): conservators, curators, researchers, digital collection specialists, educators. More than half of the museums/collections (n=9) in the study are affiliated to universities. In addition, the first two authors of this paper are researchers employed at the medical museum of a large public university in Europe (A1 is an early career researcher and A2 a member of faculty). Not all digital archives are the same. The five smallest organizations in our study (< 10 employees), used Excel spreadsheets or – in one case – OneNote to manage their digital archive. Despite being small in staff-size, 4 out of these 5 organizations (all legacy anatomical collections linked to universities and research/teaching in medical sciences) each included thousands of human remains. The rest of the museums and collections in our study – mostly mid-sized institutions – used CMS as internal databases, either proprietary or open-source, with different degrees of customization afforded by the digital system in use and the organizational governance. The degree to which researchers and the public can access the internal digital archives in our study varies. Some were only available to staff, and then to researchers or students after proper authorization, while some were connected with online collections and even third-party data aggregators. The CMS were typically connected with DAMS (Digital Asset Management Systems), and/or online collections; and/or other third-party digital cultural heritage aggregators, while the Excel and OneNote were not.

As mentioned, we also included participants (n=2) employed at a software company specialized in CMS. This helped us clarify some technical and contextual dimensions regarding the implementation and integration of CMS, in order to better shape the first stages of our study. Interviews have been conducted by A1, either in person when possible (n=7), remotely on Zoom (n=14) or, upon request from one institution, in writing (n=2). Oral interviews’ duration had an average length of 52 minutes. We used two interview guides: one designed for the staff of museums and collections, one for staff at the software company. Interviews with staff of museums/collections covered their background and experience working with databases and other digital archives of human remains; challenges and opportunities related to data work, including strategies to deal with outdated terminology. Interviews with staff of the software company covered their background and expertise; characteristics of the CMS and challenges commonly experienced by their clients when working with the database; the architecture of the public CMS and related online collections developed for the nation in which they work.

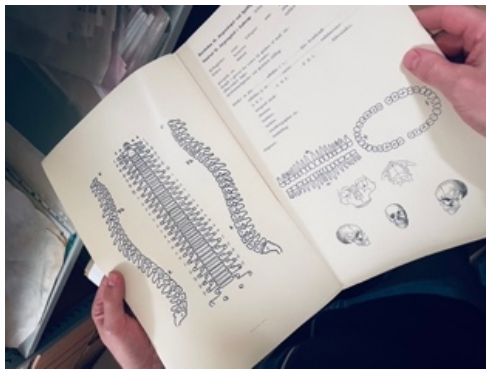


Figure 1: On the left, paper-based documentation for human remains from the archive of a medical museum in Denmark. On the right, a drawer containing records on human remains from the original index-card archives of a British museum. All photos by the first author and reproduced with permission.

4.2 Data analysis

We analyzed the empirical material using thematic analysis [13, 14], a reflexive and iterative method for identifying patterns of meaning-making (themes) across a data set. This approach allowed us to capture and understand shared experiences and meanings reported by our participants, and to document and present the results of the analysis using exemplars (quotes from interviews). Thematic analysis is flexible and can accommodate different approaches [15]. In our case we drew on Miles and Huberman [63] and we combined inductive (bottom-up) coding with deductive (concept driven) coding. We used hauntology and data work as our conceptual lenses, generating and using analytic categories based on literature while identifying new themes from the empirical data. All interview transcripts, notes and other relevant documents have been coded by A1 using the software MAXQDA. The whole process was accompanied by writing memos – taking running notes on the themes and how they interrelated.

We made sense of the dataset in several ways: first, by developing a descriptive taxonomy of data work with human remains that characterized the process. Second, we defined themes from the practice of data work, such as *ethical uncertainties*, *misfitting systems* and *collaborative decision-making*. Third, we generated a descriptive taxonomy of practical strategies developed by our participants while addressing uncertainties and hauntings. We illustrate all of the above in our Findings section.

5 Findings

Broadly, this study found that **the data work of digitizing human remains is a dynamic and relational process often fraught with uncertainties**. This work always implies working across time, depending on pre-existing analog and digital information systems, with an eye on the future users and their needs. In this section, we present a descriptive taxonomy of data work with human remains; we highlight the material and historical inheritances implied in it, and map three key areas of ethical uncertainties encountered by the staff of museums and collections. Then, we report on the emerging strategies employed by institutions to address uncertainties through collaborative decision-making and data curation processes. Lastly,

we document how digital systems can enable or constrain this dynamic data work.

5.1 A basic descriptive taxonomy of data work with human remains

Digitizing historical human remains implies bridging past, present and future ways of collecting, cataloging and classifying. During the first step of digitization, creating a new digital record, information from physical documents (if available) is turned into machine-readable data. When relevant, images are added. The historical information imported in digital systems is typically from paper-based media such as labels; index card systems; accession books; autopsy registries, etc. (see also Figure 1).

To answer our first RQ, we created a descriptive taxonomy of data work with human remains based on the empirical material. Not *all* the steps listed below were relevant in *all* organizations in the study, but most of them were. Step one is the creation of either new data structures or new records:

- **Creating new data structures:** either from scratch (i.e. in Excel when no CMS is in use, see Methods) or by adapting/improving existing software when possible.
- **Creating new records** in the digital archive, based on existing documentation.

Once a new record is created, the following steps involve different aspects of **data creation, curation, management and maintenance**. Many of these aspects are iterative and non-linear, and often involve consultation and collaboration across units, as staff ensure alignment with ethical and institutional requirements that are ever-evolving and sometimes blurry:

- **Managing media files** such as photos, 3D scans, CT scans, videos, audio files etc. if relevant.
- Creating and updating information on data protection (i.e. GDPR) and copyright licenses.
- **Cleaning the records** i.e. identifying and removing irrelevant or incorrect information. In some cases, this is done alongside audits to check for provenance, or surveys of the

collections to identify all sensitive materials, in consultation with internal or external experts. Most participants noted that the heterogeneity of the paper sources affect the data – records have uneven forms of documentation reflecting the variety of the original material. For instance, some archeological findings might have more detailed and specific information than preparations acquired in bulk from old pathological anatomy departments.

- **Improving the documentation**, for instance by annotating, translating or augmenting the records (adding research articles, blog posts or other resources). This can involve introducing inclusive language where appropriate, for example using controlled vocabularies and thesauri to guide terminology, such as the Library of Congress Subject Headings (LCSH); Medical Subjects Headings (MeSH) and Homosaurus (a grassroots international linked data vocabulary of LGBTQ+ terms).
- **Updating information on repatriation and reburial** (including changing public access rights). Discrepancies might arise here between physical collections and their digital counterparts. Sometimes, the remains leave the physical collection, but the data stays in the digital archive. In case of repatriation, even if the remains leave the premises, data on the remains typically stays in the internal system, and copyright for the assets are assigned to the new owner if possible.
- **Managing and updating access permissions** (allowing or restricting access to data).
- **Creating workflows around indigenous data sovereignty**. For example, US-based institutions receiving federal funds follow the NAGPRA framework (Native American Graves Protection and Repatriation Act) to communicate with descendant tribal officers about indigenous remains and the use of them.

The types of data work we identified show the sociotechnical complexity of the digitization process. And although some of these steps might not differ much from similar digitization processes, data work with historical remains carries uniquely complex ethical and emotional dimensions. Participants made it clear that this work carries a profound sense of care and ethical duty, equally towards the dead and to the communities who engage with them. Due to the nature of the collections, data work with human remains requires a broader interdisciplinary skillset than typically needed when digitizing ‘regular’ collections of objects or scientific specimens. This includes ethical and legal expertise; curatorial and collections-care (for instance when handling very delicate tissues or preparations during digitization); expertise in culturally-sensitive interpretation, and data management skills.

Human remains exist in a liminal space - ontologically, ethically and as digital entities. A UK participant discussed the ethics of caring for an anthropodermic book (a book bound in human skin) and its data and images. The book, made with the skin of an institutionalized woman, fits no established category but sits within the library systems and its database. Access is restricted, however images of the book can still be found online. This illustrates how human remains, in their material and digital

forms, demand ongoing institutional dialogue and efforts to ensure equitable stewardship and responsible access. Due to its ethical, relational and emotional complexity, participants highlighted the need for data work with human remains to be better supported by principles, systems and workflows.

5.2 Data work with human remains implies working with complex material, organizational and historical legacies

Debates on the ethics of *displaying* human remains might overlook the more mundane labor of managing their associated data. Yet these data, and the ways they are cared for and curated – are crucial for enabling research – including bottom-up, advocacy driven efforts. Access to the internal digital archives is typically granted to researchers and relevant communities (like communities of origin), who can trace the institutional trajectories of human remains, including those no longer on the premises. While collecting data, A1 visited an ethnographic museum that had withdrawn human remains from display. With staff support, A1 traced documentation for several remains, including some no longer in storage but listed in the internal database. One restricted-access record, for instance, detailed the unwilling journey of a skull from Ethiopia, ‘donated’ by an unknown collector in the late 1880s, later exhibited and cast for replicas and ultimately transferred to a natural history museum in the 1940s. This search was enabled by staff facilitating access to both digital and paper-based archives, as an additional form of post-digitization data work, which reflects an ethic of care for the researchers (and other communities) engaging with the remains and their contested histories, while simultaneously imposing significant time and financial demands on the institution. Even when records are not available to the general public, internal CMS are important assets for research – they are more than catalogues.

Museums only display a tiny fraction of what they hold in storage, and some hold large collections of human remains, with the result that concrete demands related to data maintenance and care (including supporting access work to restricted records, as we saw above) can be disproportionate to their resources. Data work with human remains is resource-intensive, and requires adequate digital systems, skills and funding. Many of the collections in our study were not fully digitized or were unevenly digitized, typically due to material lack of documentation, time and organizational capacity. As the quote below illustrates, local resources determine how the data is recorded and contextualized in the internal database:

“This pathological collection comes from the university, and all the descriptions we have come from them (...) they got transferred directly into our system. (...) We haven’t had the time or the resources to do our own curation of these things. Yeah, we haven’t applied a museum standard layer.”

(Conservator at a medical museum, Denmark)

Applying such a ‘museum standard layer’ is the result of strategic efforts, financial resources and staff capacity – as many other participants reported. This staff member explained that a search in their database required ‘being very creative’, as the terminology in

the titles and descriptions were as heterogeneous as the collectors and their backgrounds – ranging from medieval skeletal remains to pathological collections of organs from the 1960s or recent histological samples – they could either be in Latin, or English, or Danish, and often they used very specific scientific terminology that would be inaccessible to non-experts. Few of the institutions in this study could afford to hire specialized digital staff, carry out extensive audits to improve documentation or buy bespoke database systems. The digital archives of our participating organizations were mostly relational databases. But in four of the legacy anatomical collections examined in our study, several thousand human remains – and associated data – were overseen by a single officer with minimal external support and organized in Excel spreadsheets. All of these collections were housed and maintained in universities. The use of CMS had clear advantages over spreadsheets, facilitating complex and collaborative data work tasks: they provided a solid infrastructure for multiple users/collaborators with specific access permissions; flexibility and integration with technologies like controlled vocabularies, DAMS, APIs and third-party data aggregators; and relationality across data.

While many participants see lack of financial resources and staff as a big barrier to improving workflows and systems in data work with human remains, some have been proactively working around it by seeking funds or creating local alliances: some museums and collections pooled funds and staff with other institutions to hire specialized professionals (i.e. digital archivists, photographers, etc.). However, economy of scale as an effective organizational strategy was overlooked by many of our institutional participants.

5.3 Challenges and uncertainties in data work with human remains

Participants referred to human remains with a variety of terms from “human material” (common among conservators in medical museums) and “specimen”, to “ancestors”. This reveals different institutional, as well as individual, ways of relating to them. Some participants reported internal institutional discussions on what constitutes ‘objectifying’ or ‘dehumanizing’ ways of referring to the dead. A participant framed the work of managing historical human remains as a constant journey in uncharted territory:

“It’s a big problem for us, because all the time... we are sort of venturing into unknown territory, in something that is very sensitive. We are always afraid of doing something wrong, like disturbing people or things like that. It’s a very delicate balance.”

(Chief physician and manager of a legacy anatomical collection, Denmark)

This feeling was common among participants: working with human remains invariably means working with sensitive topics in ways staff members often felt ill equipped for. This is because internationally standardized guidelines for the digitization of remains are lacking, and clear internal policies and/or general national regulations, as well as training, are often limited or insufficient. Some of these are tied to the ghosts of old classification systems, as well as gaps and erasures in the dataset.

Overall, our findings reveal the emergence of **ethical uncertainties in three key areas** of data work with human remains, which we unpack below.

5.3.1 Revisiting and reforming outdated classification systems and language. Participants – especially from institutions without staff dedicated to culturally sensitive data – often struggled to balance preserving historical terms with using respectful language for human remains. Many of the digital archives featured some historical language linked to racist, ableist and colonialist practices of collecting and cataloguing. We found outdated classifications for races or ethnic groups, like the n-word, the term ‘Eskimo’ or words such as “idiot”, a diagnostic term used in the past and which today carries legacies of mistreatment and abuse. These terms can be either (or both) in the title/heading or the description for the records in the internal database or digital archive, as we saw earlier.

Participants struggled to find guidelines to address oppressive and offensive language – i.e. preserving history while not reproducing harmful classifications. Few institutions were actively involved with equity-oriented approaches, and adopted equitable metadata practices as part of their institutional strategy. This was the case for institutions in the UK, New Zealand and the USA, where discourse and – to some extent – institutional practices around decolonial approaches are more established – both in relation with displays and digital archives.

5.3.2 Legal and regulatory compliance (Copyright, licenses, GDPR and data protection). Our interviews revealed uncertainties around copyright, licensing and compliance with data protection measures around human remains. These also applied to photographs and 3D technologies - 3D scans and related reproductions - and CT scans or other forms of computerized images. This suggests a general lack of clear policy on the matter, sometimes clashing with frameworks such as the FAIR data principles (see Background) advocating instead for a generalized free access to ‘research data’. Concerns about AI bots scraping online collections were also voiced when the internal archive was connected with public online collections. A UK participant noted how some remains, like human hair or anthropodermic books, are less clearly regulated, which translates to extra labor to find the right institutional approach.

5.3.3 Provenance. Provenance can indicate origin (provenience) and journey (provenance) of the collected items. The amount of information available on paper-based records processed during digitization varies widely – even in the same institution. Data is typically about the collector/collection of origin, and/or the location, and in some cases could include the name of the dead individuals, and/or the physician who treated them. When provenance was reduced to the name of the collecting individual, it concealed inequitable circumstances of collection. This quote exemplifies how diverse provenance documentation can be:

“Some [human remains in our collection] are archaeological, some came from ethnographic expeditions, some from the anatomical department, you know, back in the days when poor people were taken from hospitals and other institutions after their death. (...) For some of them we have a lot of information, a few

of them have names, just a few. But some of them we don't know anything about."

(Osteologist, legacy anatomical collection, Sweden)

Sometimes very detailed information is available, i.e. about medical patients and their diagnoses, and data work includes deciding which data to leave out in the interest of privacy (see point 2) and which data to include in the digital documentation to provide relevant context for the researcher searching the database.

The ability of museums to deal effectively with these uncertainties has implications for the ethics and politics implied in sharing data with the public (when relevant) or with researchers upon request (for museums and collections whose internal digital archives are not public). As this participant employed at a software development company specialized in CMS explained:

"We have had a couple of decades where they [museums] really wanted to digitize as much as possible, and suddenly they realize that they lose ownership and control about how the material is used in other contexts."

(Support analyst, software development agency, Denmark)

Data work with human remains is thus 'haunted' in multiple ways – both by historical inheritances and by the specters of their future circulation. As we will see next, some of these ghosts are embedded into the very digital systems used to manage the collections.

5.4 Navigating ill-fitting digital systems in data work

Data work is shaped by how the procurement, implementation and use of technology meet organizational and institutional politics. We found, not surprisingly, that data work of this ilk often involves using ill-fitting digital systems, including siloed infrastructures, pre-set data structures, and legacy systems. A participant described glitches in updating permissions for sensitive material, noting that items resurfaced in the online collection even after sharing permissions had been disabled. A curator from a large Danish museum explained that the architecture of their current internal digital archive was built on 8 standalone object management systems, and it was not possible to search across them:

"We really have stand-alone databases which are not interconnected. So if you have to make an exhibit on colonial history, you have to seek in at least four different databases with their own logic, because that logic is built on the collections, which at that time mirrored also the scientific departments."

(Curator, historical museum, Denmark)

When digital archives are fragmented, data curation tends to occur in isolated silos, resulting in inconsistency. Using enterprise solutions provided by the State, when available, might also result in lack of flexibility in supporting the dynamic and ever-evolving nature of data work with human remains. Navigating ill-fitting digital systems complicates the institution's ability to manage ethical uncertainties.

Consider for example the case from a Danish medical museum, in which the historical human remains of a young woman are cataloged in the internal database under the title "*Skeleton of a 16-year-old female idiot. Osteomalacia.*" (our translation, see Figure 2). The digital record features a photo of a human skeleton in a fetal position. Attached to it, a handwritten label displays the same definition reported as 'Title' in the internal database ("Skelet af 16 aarig kvindeling idiot. Osteomalaci"). This museum's internal CMS, a database provided by the Danish state named SARA, uses a predetermined data structure. We observe two forms of dissonance in this digital record – both in the content and in the data structure – highlighting a tension between outdated terminology, rigid database categories, and the ethical imperative to preserve the dignity of human remains while providing meaningful contextualization. The title reproduces an outdated ableist classification system ('female idiot') as main heading, while the data structure classifies the remains in "Record type" field, as "Cultural history objects" in the absence of a category for records that are not 'objects'.

This example also illustrates the unfulfilled potential of augmenting collection records with secondary documentation. Ideally, materials such as additional research, expert reflections, or contextual insights, could be visualized and accessed at a glance. In practice, however, they are often buried, particularly when the digital system is not designed with a clear focus on findability. In this instance, A1 discovered a Word document attached under the "Digital references" section of this record, at the bottom of a long list of data fields, most of which empty. The file, automatically named with a numerical identifier by the SARA system that gave no clue as to its content, contained an article by a human remains conservator who had worked with the skeleton together with a doctor, offering reflections on the historical use of the term "idiot" as a medical diagnosis and insights into the physical condition and lived experience of the young girl whose skeleton was documented. Despite its rich contextual value, the document was rendered nearly invisible, deep in the system, demonstrating how automated file naming and database design can obscure important interpretive materials and limit the practical impact of record augmentation.

At the time of writing, this medical museum does not have online collections available to the public. However, this record and its image appeared in the Danish state's online database, Museerne Samlinger (MUSSAM), under the same title reported above – although the 'Publish on website?' field was left empty in the museum's original record. The additional documentation on the girl, which was attached as a Word file, was not available on MUSSAM.

Upon contacting the Danish Agency for Culture, we learned that the MUSSAM database was linked to a legacy system called REGIN, rather than the newer database SARA. Since the end of 2019 and until the time of writing, museums have had read-only access to MUSSAM and have not been able to modify or remove data directly. This illustrates how **legacy digital systems can constrain dynamic data work, limiting both the ongoing curation of records and the ability to manage sensitive materials effectively.**

Shortly before the final publication of this article, MUSSAM underwent a complete redesign. All records from the medical museum have been dropped from the new online collections, which only link to the databases of museums that are part of the Danish Ministry of

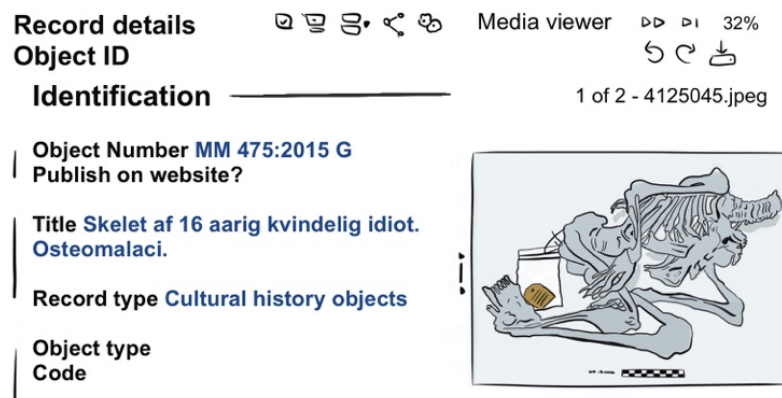


Figure 2: Illustration of a screenshot showing the digital record in the internal database of a Danish medical museum. We decided to render the screenshot as an illustration in order not to share the original photo of this unknown person's human remains, while at the same time providing the reader with a visual sense of the record in the database. The original screenshot was taken on December 10, 2024.

Culture. After many years, the digital record of the girl's skeleton has disappeared from public online view – at least for now – and rests in the internal database.

5.5 Working with uncertainties and challenges: emerging strategies

So far, we've outlined a taxonomy of data work with human remains, examined how it is shaped by situated organizational structures and resources; outlined three key areas of uncertainty faced by data workers and highlighted challenges posed by ill-fitting digital systems. We now turn to the emerging strategies participants used to address the challenges and uncertainties they face. Two overarching approaches stand out: at the organizational level, **collaborative decision-making and sense-making processes** to support the ethical management of human remains; and at the micro level, practices of **equitable data curation**. In some cases, like the one presented above, the governance and architecture of digital systems were concrete obstacles to collaborative data work practices of curation and maintenance.

We found that collaborative decision-making often cuts across institutional boundaries – for example through **consultation with experts**, like the creation of ad-hoc committees to support new policies, or guidelines. This also includes communities of origins or descendants (when those are identified through ad-hoc surveys). Our US participant explained how through the NAGPRA framework (Native American Graves Protection and Repatriation Act) their medical museum was able to contact representative officers of possible descendant indigenous communities for the indigenous North American remains in their collection, and had them advise about repatriation and use, and in some cases, use of the 3D likeness of them. But they noted that, for *non-indigenous descendants*, new forms of collaboration need to be established:

“People talk about 3D models made of people's remains (...) we really need to have some shared thought

processes about what we think is a best route forward, and to ensure that we are including a broad base of people in what those best practices are. Because I don't think is something that you and I can sit and hammer out. And [non-indigenous] descendants of people reflected in our collections don't even know their remains are here and those folks should have a voice in determining what is best practice.”

(Digital collection officer, medical museum, USA)

Consultation with the public is a collaborative decision-making strategy used by our participants in the UK and the US, particularly to tackle ethics of display, including online: one museum undertook a two-year community engagement initiative to discuss ethics and politics of caring for over 6000 human remains, including on using images in research and education. Some organizations also **hired new staff with relevant ad-hoc expertise**, like consultants on sensitive collections, data officers or researchers conducting provenance audits and similar. Another strategy to support collaborative decision-making in data work was **building knowledge sharing networks (informal or formal) across different types of institutions**: some participants relied on informal networks to debate the pros and cons of implementing and adapting open-source software for scientific collections (like Specify) not specifically geared towards human remains. Lastly, some **created ad-hoc digital feedback channels for the public** (i.e. in the public-facing version of the digital archives, when available) with pop-up statements eliciting community feedback regarding hurtful language, while at the same time making visible to the public this aspect of ongoing data work – see Fig. 3

Once some institutional ways to support decision-making are identified and established, staff would proceed to developing protocols or guidelines that were typically unique to the organization. For example, as this curator working with a forensic anthropology collection explains:

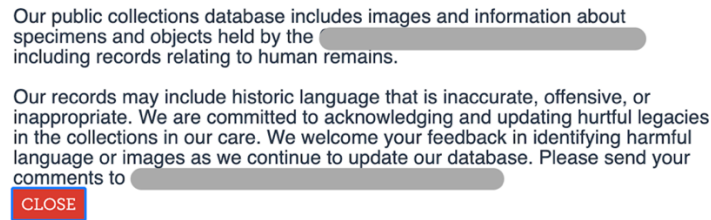


Figure 3: Screenshot of a pop-up statement including a feedback option; from the online collection homepage of a medical museum, taken on December 10, 2024.

"Apartheid (...) stained our country for years. And so we are very racially sensitive, (...) You have to correct for the past, in terms of terminology that is considered derogatory (...) but I have to keep the historical account, right? I have this derogatory nomenclature tied to population affinity in my master catalog. And in [the researcher-facing catalog] when it comes to terminology tied to population affinity, I use our census data, our government-prescribed definitions for the populations. Yeah, I feel it's safest to safeguard sensitivities, because it's a very sensitive issue. (...) If I go with something as sterile as a government definition, I think is the best way, at present." (Curator, medical museum, South Africa)

As the quote above exemplifies, equitable data work with human remains in digital archives requires balancing historical accounts and ethical concerns using a set of micro-strategies which we unpack below:

- **Layering and filtering:** Creating different layers of information in digital records and filtering what is searchable in the public-facing side of the digital archive, by restricting access to some data, or adding click-through content notices. Following decolonial approaches, some institutions have a special emphasis on the curation of titles/headings. **Maintaining outdated and offensive terms in the title/heading is often perceived to reproduce harmful hierarchies in classification systems, but erasing them is considered against the duty of preserving historical information.** Some choose alternative titles while keeping the problematic terms within the description. For instance, staff at a Swedish university collection updated the digital record of a repatriated cranium, first collected in 1889 by Swedish researchers, to the new title: "Kranium I.11: Australien," while relocating the original heading, "Cannibal, North Queensland", to the description field under "original markings." The complete record, including its layers of historical terminology, is also accessible through the Alvin Platform for digital collections and digitized cultural heritage. In some cases, the offensive terms were only kept in the internal database but not in the public-facing version. In certain instances, offensive terms appear only in photographs, on the original label placed next to (or onto) the specimen.

- **Standardizing:** Using controlled vocabularies and thesauri (see also the last item on this list) for nomenclatures to standardize metadata. Some might use contemporary anatomical terms, or census terms as in the South African example. But standardizing still present open questions, particularly in relation with outdated diagnostics terms.
- **Augmenting:** Augmenting digital records was done by adding files containing historical information, more information regarding provenance, links to new research done on the remains, or other information to better contextualize the record. Augmenting mostly included text media, with a surprising lack of audio, video and even visual media.
- **Translation work for inclusive documentation:** Creating and managing an institutional list of appropriate and inappropriate synonyms to be used in public-facing context (and listed in the internal database, for instance under "primary documentation") to substitute (in titles) or complement (in the description) outdated terms.
- **Adopting grassroots technologies for equitable metadata (rare):** Using equitable controlled vocabularies/thesauri like Homosaurus, an international linked data vocabulary of LGBTQ terms, to replace and complement outdated terms. Another tool mentioned by a participant is TK labels (Traditional Knowledge labels¹).

Key factors like staff literacy, strategic goals stressing equitable data curation, and available resources in terms of finance and capacity were crucial in determining how each institution could dedicate time and effort in equitable data curation practices. These strategies of data curation were, in some cases, the result of the individual initiative of staff in charge of digitizing – or were applied only to specific records.

6 Discussion

6.1 Ghosts in the system: historical, organizational and digital specters in databases of human remains

In this study of the intricacies of digitizing historical human remains, we extended the almost non-existent body of interdisciplinary research on this subject [52, 53, 77]. We contributed to the

¹A set of digital tags co-designed with Indigenous communities and aimed at providing additional information about digital cultural heritage materials in the public domains or owned by museums, archives etc. They include information about what kind of access and circulation of Indigenous digital heritage is desirable.

growing body of HCI, CSCW on data work [11, 26, 65, 69, 86] by focusing on an underexplored domain that raises new and complex questions – the field of difficult or dissonant heritage [59, 87]. These terms refer to cultural or scientific heritage tied to death, human suffering and social inequality, typically characterized by contested legacies. Within critical data studies, scholars have investigated how data-sharing practices in the context of difficult heritage generate tensions—balancing the imperative to document the past with the need to confront the unjust practices that these records expose [42]. Similarly, a growing body of research on critical care work in museums identifies collection management as *critical care practice* [54, 64] actively addressing past injustices. Our findings resonate with this work and with HCI and CSCW research on justice-oriented data work in other domains [26, 30, 65, 81], showing the invariably complex politics and frictions embedded in this form of critical care work, and highlighting how it is also always driven by a mix of individual creativity and collective efforts and workarounds [26, 86] like in the case of the South African database where a manager adapts current census categories to address the specters of old classifications in the researcher-facing database. Understanding and supporting the complexity of data work with human remains – and other similar forms of difficult or contested heritage – has important social and scientific implications – as system design, maintenance and repair shapes how data is created and modelled, accessed and experienced.

Drawing on the hauntological turn in social science and heritage studies [7, 39, 40, 83] we affirm the view that “museums, through their spaces, operations, and objects, are haunted and hauntological” [91:72]. We show that **caring for historical human remains and their data is a dynamic, collaborative process that involves dealing with the spectral traces of ‘many ghosts’**. First, digital archives of remains are inhabited by the ghosts of their colonial and inequitable histories of collection and acquisition [20,34,43,73], as many of our examples showed. Second, these digital archives are haunted by the absences, erasures, and inconsistencies of collection records, and by further gaps in institutional guidelines and regulations [36, 52, 53, 66], generating anxieties and questions regarding data circulation and ethical accountability. And third, these documentation and regulatory inconsistencies are overlaid onto collection management systems entwined with various types of digital specters. Some – like the glitches that make corrections and repair disappear in big online collections – are akin to mid-century *gremlins*, the mischievous creatures blamed for malfunctions in aircraft [17]. Other are hauntings of sedimented, disconnected layers of sprawling digital infrastructures, revealing malfunctions in interoperability and dis-alignment in timelines of use, with ghost records lingering in legacy systems connected with online collections, like in the example of the 16-year-old girl’s skeleton from Denmark. Here we see legacy software acting as a hauntological creature composed by “multiple lifetimes of different parts of the system (...) all of which are entangled and aging or obsolescing at different rates” [23:1513], generating new, uncontrollable forms of digital absent presence [73]. The data work of curating and augmenting the record becomes invisible, while images of the skeletal remains and their obsolete classification are shared widely with little specifications or contextualization.

These specters pose everyday challenges for data workers and for institutional accountability. Since data work with human remains necessarily puts the living in a form of dialogue with the dead, data workers have both an opportunity as well as an obligation to acknowledge and interact with the ghosts of past collectors, archivists or curators that linger in digital systems, as well as the digital specters of future data re-circulation, whether through 3D models or AI bots scraping online collections. We argue that data work with difficult heritage is not just ‘data management’ – it is relational work that often holds accounts of intimate relationships with the dataset, from ethical uncertainties to deeply felt anxieties about releasing data about the dead ‘into the wild. It is also shaped by the fluctuating temporalities of past actors, systems, and structures, of current concerns and values and speedily evolving digital systems that bring new challenges and concerns. The “ghosts in the system” therefore also fluctuate in terms of how their presence is perceived and addressed.

6.2 ‘Data hauntings’ and data work with contested heritage

In data work with human remains, the tensions between past scientific practices, contemporary ethical frameworks and the inherent frictions and potentials of digital systems manifest in what we conceptualize as ‘**data hauntings**’. Building on hauntological approaches to critical heritage, data and social justice [7, 40, 84] and on HCI and CSCW research that has examined the labor, politics and affective dimensions of data work [11, 26, 65, 69], we propose data hauntings as an analytic tool for *understanding and designing* sociotechnical systems for contested or ethically sensitive digital assets.

Data hauntings describe how digital repositories of contested assets are simultaneously haunted by i) their historical legacies, ii) the gaps, inconsistencies and erasures in their documentation and regulation, and iii) their complex digital materiality. These hauntings invariably surface not only in the data themselves – generating anxieties and open questions on data circulation, curation and accessibility – but also in the digital infrastructure and its dependencies. We contend that data hauntings are not “bugs” but features of these sociotechnical systems and essential part of sensemaking in the process of digitization. Concepts of ‘ghosts’ and ‘hauntings’ have been used in hauntological literature to highlight how the past and future always complicate the present [3, 28, 39], inviting us to identify how specters of past data, knowledge systems, systemic injustice, or material structures shape our world [7, 28, 83] creating frictions, glitches and misfits. But also, equally important, they invite us to pay attention to the specters of future accountability [28, 40, 68, 91] and highlight that ghosts often generate some form of collective action or response [28, 40, 83].

Thus, one of the points of hauntology is also a sociotechnical one, for it enables thinking about equitable data work in a collaborative and relational sense: the conversations with ‘ghosts’ should include stakeholders beyond the digitizer, fostering a shared understanding of data work as ethically accountable. The internal archive of contested historical assets often becomes part of distributed systems, existing across multiple institutions and servers and linked to different APIs. As an interface, it acts as a *connecting medium* [9] –

Stakeholder Map - Collaborative Decision-Making

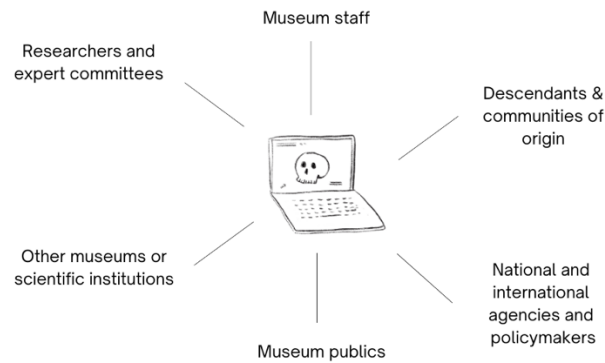


Figure 4: A stakeholder map of the actors involved in collaborative decision-making around data stewardship

it links data workers with people (alive *and* dead), artefacts, and practices in ‘extended spatial and temporal relations’[85:284]. And as we show, **data hauntings call for many different collective – and systemic – strategies to handle them across institutions and areas of expertise**: multiple stakeholders need to be involved in the collaborative decision-making processes around the stewardship of human remains and their data (see Fig. 4).

Dealing with data hauntings requires teamwork, from continuous forms of co-creation, like online feedback forms to evaluate the online use of language or images, to efforts mobilizing internal and cross-institutional resources, reworking policies and improving literacy and support around digitization. In addition, a hauntological lens aligns with recent calls for a more historicist sensibility in CSCW and HCI. [78].

We argue that the concept of data hauntings is a useful contribution to HCI and CSCW scholarship on equitable data work, particularly in the domain of contested digital assets. The concept extends previous HCI and CSCW literature on data work [11, 26, 65, 69], by emphasizing how this form of labor is always shaped by the specters of historical inheritances, the ghosts of future ethical accountability, and the messy materiality of layered digital infrastructures.

In our case, the concept helped focus on three intertwined dimensions: the *layered temporalities* embedded in data work, the *ambiguities and inconsistencies* in documentation, classification and regulations, and the *affordances and constraints of digital systems* in museums and collections. By foregrounding these dimensions, data hauntings make visible where sociotechnical frictions arise, and where the opportunities for policy and design lie – such in interoperability breakdowns, uneven ways of standardizing and curating data, issues with copyrights and data circulation, conflicting ethical obligations (like FAIR data frameworks clashing with other archival and data protection rules) or over-complicated data structures covering many tasks. The contested nature and complex ethical frameworks around human remains generates additional

forms of *articulation work* [75], with museum staff providing ad-hoc assistance to support researchers doing archival work in the internal databases, overseeing data circulation. Beyond the focus of this paper on contested heritage, a hauntological lens in HCI can be useful in illuminating these frictions in many other organizational contexts of sociotechnical data work. One example could be those involving sensitive or contested data, where legacy systems need re-examining in light of organizational, regulatory and infrastructural changes.

Our findings demonstrate that curators, registrars, collections managers, IT staff, researchers, and community stakeholders all participate in the decision-making that shapes the stewardship of both the remains and their data. As such, the next section offers our recommendations directed at HCI researchers and practitioners who design or study collection-management systems, as well as museum professionals or ministry-based officers responsible for data governance, emphasizing the need for infrastructural approaches that acknowledge and work with, rather than attempt to erase, the hauntings embedded in these systems.

6.3 Implications for design and practice: a hauntological framework for equitable data work

Databases of human remains and other contested assets are collaborative and ever-evolving sites of knowledge production. How can we design in ways that support data work practices that are collaborative, dynamic and fluid? We argue that the goal is not to eliminate the ghosts of the past, but to preserve their traces, enabling meaningful engagement with them [3, 28, 36], both at the institutional level and within the digital system, as a way of ‘staying with the trouble’ [46]. Based on our findings, we propose a **hauntological framework for rethinking, (re)designing and maintaining digital systems that enable equitable data work**

with human remains and other contested assets. This framework is grounded on three principles:

1. **Historical Trace-ability:** To preserve historical traces within databases rather than deleting them, retaining evidence of earlier classifications, practices and terminologies. This means supporting tasks like augmentation, annotation, filtering - maintaining accuracy and enabling reinterpretation (i.e. creating clear 'primary documentation' and 'secondary documentation' text fields and rephrasing problematic headings and titles, while keeping and contextualizing those in the description field and primary documentation). In this way, the digital archive can become a layered palimpsest [36] of archival practices.
2. **Ethical Accountability:** To ensure that dignity and respect for human remains [49] are upheld, in accordance with evolving ethical frameworks. This involves regular processes of consultation and other collaborative strategies, as well as on existing guidelines such the 'American Association for Anatomy Recommendations for the Management of Legacy Anatomical Collections' [24] where relevant. It also involves adopting systems that allow for integration and/or customization with equitable data structures and standards; providing updated terminologies, etc. Processes related to data protection and access restriction should be periodically reviewed, also in relation to the ethics of imaging, for example AI scraping, and other new and emerging digital ways of sharing data about people who did not have an opportunity to give their consent.
3. **Searchability:** To ensure that information within structure data systems is discoverable and usable by staff, researchers (see also point above on standardization), and - when appropriate and in line with institutional policies - other stakeholders and the broader public. This involves reducing excessive information structuring in the back-end and the interface of digital archive - developing user-centered interfaces that reduce cognitive load in the digitizer and allow to concentrate on few key categories; improving metadata and other ways of supporting querying while accommodating appropriate access to data, aligned with institutional policies.

In practice, this entails developing policies and organizational strategies that reflect the complexity of digital data stewardship; adopting or redesigning digital systems that more effectively support work with contested data assets; and identifying both internal and external stakeholders who can enable these changes, including through financial support. We suggest focusing on these three overlapping areas:

Policy making:

- Create accessible policies and guidelines covering all aspects of the digital afterlife of human remains (i.e. data and image re-circulation, including 3D images; AI bot crawlers; obsolete language; copyrights; FAIR principles, etc.).

Organizational change:

- Consider pooling funds with other institutions (i.e. to cover specialized staff or software for digitization).
- Support and strengthen ongoing collaboration, networks and consultation work.

- Support literacy and training of staff on ethical data management, data sovereignty, and emerging issues in relation to digital assets.

Digital systems (procurement, design and maintenance)

- Adopt user-centered, interoperable systems.
- Adopt CMS configurations that include primary documentation fields to preserve historical records and secondary documentation fields that enable the augmentation of records, reflecting new research, community inputs, new interpretations and ethical standards in the data structure and the data curation of titles.
- Support integration with *equitable metadata standards*, folksonomies and other relevant data structures.
- Consider context: design digitization interfaces that support core tasks without burdening data workers with unnecessary cognitive load. Keep the input fields to a minimum.
- Ensure that online collections (when available) are linked with modern systems and regularly updated to reflect the dynamic nature of human remains, such as reburial, repatriation, or changes in permissions. In the example of the unnamed skeleton of a young woman, the outdated title could be moved from the title/heading to the "primary documentation" and "description" field with contextual notes, and substituted by a standardized title using thesauri, controlled vocabularies or other structured metadata, and implementing descriptive filenames.

With an eye to the organizational aspects of data work [26, 69, 86], data hauntings can also refer to organizational and institutional history and legacies. They can represent traces of organizational decisions, missions and structures, which can be entwined at different degrees with the specific instances of human remains and related data - hence also the relevance of a hauntological lens on a broader set of domains where data work occurs. As we show, awareness of the need for change does not necessarily translates into easy action, as data work with human remains often occurs in organizations experiencing some levels of financial strain and understaffing, and in some cases the ethical commitment is down prioritized in the absence of clear policy frameworks, aptly designed systems and/or institutional guidelines are not in place. As outlined in Fig. 4, any process of change invariably involves multiple stakeholders, which increases complexity but also new opportunities for sharing knowledge and resources.

As such, designing and maintaining for equitable data work, with difficult heritage and more broadly, calls for a non-linear, iterative process of reconfiguration. This involves rethinking institutional but also national policies; technologies and architectures; workflows and collaborative work (within and without the institution) as well as the financial resources, literacy and professional expertise to respond to evolving ethical and technical contexts. The emphasis on iteration and non-linearity also allows for greater emphasis on and attention to both visible and invisible gaps between ethical intentions and actual practice, as it creates processes where these gaps can be surfaced, recognized and worked upon.

Data hauntings can be a generative foundation for cultivating what Ezio Manzini calls 'enabling ecosystems' [60], or new forms of

collaborations which catalyze and systemize resources to produce new ideas and shared visions. As we show in the findings, expert consultation and co-creation, together with sharing financial assets and expertise, were some of the strategies that effectively supported data work. Digital archives of difficult heritage are important sites of dialogue and collective responsibility. Even when not linked to online collections or public repositories, they provide access to data for researchers and other stakeholders (such as communities of origin, or individuals related to the historical remains) – which means taking into account the conflicting agendas and potentials of the quickly changing landscape of digital research [61, 77]. Thus, the redesign of policies supporting ethical and equitable data ecosystems should consider how digitization protocols must address areas of uncertainties which include complex legal and technical aspects, such as copyright of repatriated assets, the ethics of *museomics* (the study of genomic data obtained from historical and ancient DNA from museum collections), the risks of AI bot swarms and more.

7 Conclusion

This study has examined the complexities of digitizing historical human remains through the lens of *hauntology*, and outlined implications for equitable data practice and system design. We have shown how data work with human remains is relational, political and haunted, as it requires engagement with the specters of past historical inheritances and future institutional responsibilities, while also contending with constantly evolving digital infrastructures and research landscapes. Our analysis highlights that data work with human remains is fraught with uncertainties in three key areas: 1) confronting outdated and oppressive classification systems and terminologies; 2) ensuring compliances with legal and regulatory frameworks - including copyright, privacy protection and the ethics of emerging technologies and open data frameworks - and 3) provenance. We show how data workers in museums and legacy anatomical collections respond to these uncertainties through strategies such as data curation (i.e. augmenting, filtering and translating) and a variety of collaborative decision-making and sense-making initiatives. However, we found that these strategies can be constrained by the frictions that arise from existing digital systems, including mismatched data structures that do not fit the users' needs, searchability breakdowns, reliance on legacy systems, and siloed infrastructures. To account for the layered challenges embedded in digital archives of human remains, we propose the concept of *data hauntings*: a way of understanding how historical, epistemic and technical legacies persist within sociotechnical systems as spectral traces. We argue that data hauntings are not anomalies but rather structural features, demanding collaborative and equitable approaches to data work, that engage multiple stakeholders beyond the digitizer. Drawing on our findings we propose a hauntological framework for designing and maintaining interfaces and systems to support equitable data work, grounded on three principles: Historical Trace-ability; Ethical Accountability and Searchability. We show how these principles can be operationalized in strategic areas such as policy making, organizational change and the procurement, design and maintenance of digital systems. Supporting equitable data practices requires more than technical fixes or policy interventions – it calls for reconfiguring

institutional policies, technologies, workflows, collaborations, financial resources and taking into account new and emerging forms of expertise. And, ultimately, also learning how to converse with and respond to the ghosts in our data systems.

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