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Review

Developing a Data Set for Mpox Disease: A Scoping Review and Consensus-based Classification

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Abstract

Introduction: The emergence of Mpox as a major public health problem has drawn attention toward comprehensive data that could inform effective disease management and control efforts. This study aims to create a standardized data set for Mpox, which will be useful for purposes of collecting, analyzing, and reporting critical data elements.

Methods: The scoping review was done in accordance with Arksey and O'Malley's framework and under the PRISMA-ScR guidelines. Searches for the terms "minimum data set" and "Monkeypox" were conducted without time limitation until June 9, 2024, in the PubMed, Scopus, and Web of Science databases. Two researchers independently screened the titles, abstracts, and full texts. Data extraction was carried out in Excel.

Results: 670 studies were identified, although the inclusion criteria was met by 16. Most studies were conducted in the Democratic Republic of the Congo. Data elements were divided into administrative (10 core and 15 extended data elements) and clinical (26 core and 51 extended data elements). Patient demographics, socioeconomic factors, residence, and healthcare providers appear in administrative data. Disease exposure, symptoms, medical history, diagnostics, treatments, follow-up, and vaccination form part of the clinical data. A total data set with 104 elements was created.

Conclusions: Identifying the data set is crucial to improving the public health responses to Mpox outbreaks. It will enable healthcare professionals and researchers to enhance disease monitoring and control efforts globally. Future studies should validate the data set in diverse settings, adapt it to the disease's evolving nature, and integrate it into health information systems for real-time data utilization.

Key words: Mpox; data set; core data elements; extended data elements; public health surveillance; infectious disease data.

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Introduction

Viral infections are responsible for many emerging diseases, posing significant public health challenges due to their high transmissibility and potential for rapid spread [1]. The concurrent emergence of Mpox and COVID-19 focused attention on the vulnerability of the global system to the simultaneous attack of two pathogens, which calls for reevaluation of the current surveillance paradigms [2,3]. The Mpox virus (previously known as Monkeypox) has become a significant public health concern, particularly in the wake of the global outbreak of 2022 [4]. The virus was initially identified in 1958 during an outbreak in primates that were raised for research in Copenhagen, Denmark. The first human case was reported in the Democratic Republic of Congo (DRC) in 1970 [5]. Mpox is a zoonotic disease, indicating that it can be spread from animals to humans. It often remains prevalent in wild animal populations, especially in Central and West Africa [6]. Human Mpox cases have dramatically surged in recent years, with epidemics documented in many non-African nations, including the US, Europe, and Asia [4,7]. This rise in the cases is attributed to several factors, including environmental degradation, urbanization in areas with animal reservoirs, and the genetic diversity of the virus, which

allows it to infect various animal species across wide regions [8-10]. The DRC alone reports over 1,000 cases annually, highlighting the endemic nature of the disease in certain regions [11]. Furthermore, the increasing incidence of Mpox, particularly among immunocompromised individuals, raises concerns about the potential for the virus to evolve and adapt to human populations [12,13].

Mpox was declared a Public Health Emergency of International Concern (PHEIC) by the World Health Organization (WHO) on July 23, 2022, in response to its dissemination to more than 70 countries [14,15]. There should be a declaration of the end of this global emergency. It was done in May of 2023, whereby efforts towards timely resurgence and robust public health strategies continue to impart reasoning for an unending, high-quality surveillance system, which shall be maintained [16]. This declaration emphasizes the pressing necessity of effective surveillance, prevention, and control measures to alleviate the effects of Mpox outbreaks [14,15]. This disease presents with various symptoms, including skin rash, fever, lethargy, chills, headache, and swollen lymph nodes, which can often be confused with other viral infections such as chickenpox [17,18]. Effective and prompt data collection is crucial for differentiating Mpox from other diseases, monitoring its spread, and executing targeted interventions.

Effective surveillance and data collection are impeded by several obstacles, despite the increasing recognition of Mpox as a public health threat. The absence of standardized reporting mechanisms across healthcare systems and regions is a significant obstacle. One of the major drawbacks is the varied application of case definitions, contact tracing indications, and other basic public health practices across the major international health agencies as well as national health systems[19]. This inconsistency results in fragmented data, which complicates the comparison and analysis of information across outbreaks [8]. Besides, the clinical presentation of Mpox can be easily misdiagnosed and underreported, as it is easily confounded with other diseases, such as chickenpox or smallpox [17]. More specifically, in 2022, a few novel presentations were witnessed during the outbreak, one being localized anogenital rash, which conferred a greater hurdle in early identification and adjusting public health responses, which included systematic screening for concomitant sexually transmitted infections (STIs) [20]. Furthermore, in resource-limited settings, where Mpox is often endemic, the capacity for laboratory confirmation and data collection is limited, further complicating surveillance efforts [6]. To address these challenges and enhance the consistency and quality of Mpox data, creating and utilizing a data set specifically designed for Mpox may be an essential solution.

The concept of minimum data set (MDS) has been widely recognized as a critical tool in healthcare for standardizing data collection, analysis, and reporting. The MDS comprises essential data elements necessary for monitoring and managing diseases, enabling healthcare providers to make informed decisions and improve patient outcomes [21]. Through a uniform, standardized framework applicable worldwide, it directly addresses the discrepancies now visible in national surveillance and reporting schemes to ensure compatibility beyond existing general public health data standards [19,22]. Previous studies have demonstrated the utility of MDS in managing various infectious diseases, including COVID-19, tuberculosis, and HIV [23-25]. However, there is currently no standardized data set for Mpox, which limits the ability of healthcare systems to monitor and respond to outbreaks effectively. Current frameworks for infectious disease surveillance frequently do not meet the specific requirements of Mpox, as they lack crucial data elements, including comprehensive exposure histories, genetic sequencing information, and long-term outcomes for patients.

This gap in the existing frameworks underscores the need for a dedicated data set for Mpox. To address this critical gap and develop a standardized data set for Mpox, a scoping review methodology and consensus-based classification was chosen for this study in terms of its ability to systematically map the existing literature, identify key concepts, gaps, and areas for further research, and synthesize diverse sources of information, making it particularly suitable for emerging infectious diseases like Mpox, where the body of evidence is still evolving [26]. This review identifies and proposes a data set for Mpox disease, establishing a standardized tool for systematically collecting, analyzing, and reporting critical data elements. The study aims to enhance the understanding of Mpox epidemiology, strengthen surveillance efforts, and inform the creation of targeted interventions to prevent and control Mpox outbreaks on a global scale.

Developing a standardized data set for Mpox has significant implications for public health practice and policy. By providing a unified framework for data collection, the data set will facilitate more accurate and timely reporting of Mpox cases, enabling better monitoring of the disease's spread and the effectiveness of interventions. This will, in turn, facilitate more

informed decision-making among healthcare providers, researchers, and policymakers. Additionally, the data set will promote international collaboration by ensuring that data from various regions are comparable and can be aggregated for global analysis. Ultimately, implementing a data set for Mpox will contribute to more effective prevention and control strategies, reducing the disease burden on affected populations and healthcare systems [22,27].

Methodology

To set up the Mpox literature dataset, there was a scoping review and consensus-based action conducted in 2024. In the Mpox illness, data sets often have fixed values for every data piece [28]. An entry defines a data element, which is the smallest data unit in a data collection that reflects a single fact [29]. We found a data collection in this study that may include several types of information that are necessary for reporting, clinical decision-making, and research.

Design

The scoping review of this study was performed using Arksey and O'Malley's framework, the most used in referencing the multi-phased scoping studies [30]. The framework involves five stages: (1) identification of the research question, (2) identification of the relevant studies, (3) study selection, (4) charting of data, and (5) collation, summary, and reporting of the results. This iterative framework emphasizes coverage of literature and transparency of methods to inform research mapping, dissemination of findings, and identification of evidence gaps.

Additionally, we implemented the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Review (PRISMA-ScR) guidelines for this scoping review [31].

Identifying the Research Question

(1) What are the data elements of Mpox disease?

(2) What is the minimum data set for Mpox disease?

Identifying the Relevant Studies

The PubMed, Scopus, and Web of Science databases were used as sources for this investigation. These databases were searched using keywords associated with Mpox disease (Monkeypox, monkeypox, monkey-pox, monkeypox virus) and the minimum data set concepts (Minimum Data Set, Dataset, Common data elements, Data elements, Data recording, Data utilization, Common data, Data collection, National data set, Core data set). Keyword MeSH words are highlighted in bold. Searches were conducted without time limitations until June 9, 2024. Two researchers [AS & SP] created the search technique by merging two sets of keywords, "minimum data set" and "monkeypox" (Table 1). A "grey literature" search was also done, which included the websites of the World Health Organization (WHO), the Pan American Health Organization (PAHO), and the Centers for Disease Control and Prevention (CDC).

Selecting the Studies

The retrieved study was evaluated using two criteria: 1) title and abstract screening, and 2) full-text study checks. The titles and abstracts of all papers were scrutinized based on the inclusion criteria, and full texts were reviewed as necessary. Two authors (FB and FB) conducted a manual evaluation of the titles and abstracts to identify those that aligned with the study's objectives. Disagreements were addressed by conversation or consultation with a third reviewer (LA).

The inclusion criteria were all publications published in English that focused on the establishment of Mpox illness registries and the formulation of a minimal dataset for Mpox disease. Studies that analyzed registration data without specifying the data

Table 1. Search strategy for different databases.

Database	Search strategy
PubMed	(("Minimum Data Set"[All fields] OR "Dataset"[All fields] OR "Common data elements"[All fields] OR "Data elements"[All fields] OR "Data recording"[All fields] OR "Data utilization"[All fields] OR "Common data"[All fields] OR "Data collection"[All fields] OR "national data set"[All fields] OR "Core data set"[All fields] OR **"Dataset"**[Mesh terms] OR "Common data elements"[Mesh terms] OR **"Data collection"**[Mesh terms]) AND ("monkey pox"[Title/Abstract] OR monkeypox[Title/Abstract] OR "monkey-pox"[Title/Abstract] OR "Monkeypox virus"[Title/Abstract] OR **"Monkeypox"**[Mesh terms] OR **"Monkeypox virus"**[Mesh terms]))
Web of Science	((ALL=("Minimum Data Set") OR ALL=("Datasets") OR ALL=("Common data elements") OR ALL=("Data elements") OR ALL=("Data recording") OR ALL=("Data utilization") OR ALL=("Common data") OR ALL=("Data collection") OR ALL=("national data set") OR ALL=("Core data set")) AND (TS=("monkey pox") OR TS=("monkeypox") OR TS=("monkey-pox") OR TS=("monkeypox virus")))
Scopus	((ALL (*"Minimum Data Set"*) OR ALL (*"Datasets"*) OR ALL (*"Common data elements"*) OR ALL (*"Data elements"*) OR ALL (*"Data recording"*) OR ALL (*"Data utilization"*) OR ALL (*"Common data"*) OR ALL (*"Data collection"*) OR ALL (*"national data set"*) OR ALL (*"Core data set"*)) AND (TITLE-ABS-KEY (*"monkey pox"*) OR TITLE-ABS-KEY (*"monkeypox"*) OR TITLE-ABS-KEY (*"monkey-pox"*) OR TITLE-ABS-KEY (*"Monkeypox virus"*)))

items were rejected. The study excluded seminar abstracts, letters to the editor, theses or dissertations, review papers, and papers whose full texts were unavailable.

Charting the Data

A single reviewer (HE) manually extracted the data using Excel (Microsoft, 2019), and another reviewer (SP) verified the results. The extracted information included the first author's name, year of publication, study goal, country, and reported data set or data element related to Mpox disease.

Collating, Summarizing, and Reporting the Results

All data elements were subjected to a consensus discussion by three infectious disease specialists and this research team during the data merging process, where commonly understood but overlapping items were eliminated to ensure clarity and prevent redundancy. It retained all variants of data if at least three included studies contained it or were highly emphasized by national reporting guidelines (e.g., WHO, CDC). Data elements mentioned fewer than three times, but viewed as relevant to clinical documentation, epidemiology, or public health reporting, were retained based on the consensus of the experts. To ensure transparency in the synthesis process, every decision regarding inclusion, merging, or exclusion was discussed and documented in team meeting minutes. This was then further followed by a series of two-hour meetings with three infectious disease specialists to classify and refine the list. The final list of data elements was based at WHO, Mpox Case Reporting Form [32], CDC Short Case Report Form for Mpox [33], expert opinion, and team research opinion. Each of the data elements was then categorized into core data elements, apart from extended data elements. These were described into two further groups, namely, administrative and clinical data, in terms of the standard classification of healthcare data [21,34,35]. Findings are represented in tables and figures using data from included studies.

Figure 1. Scoping review flowchart.

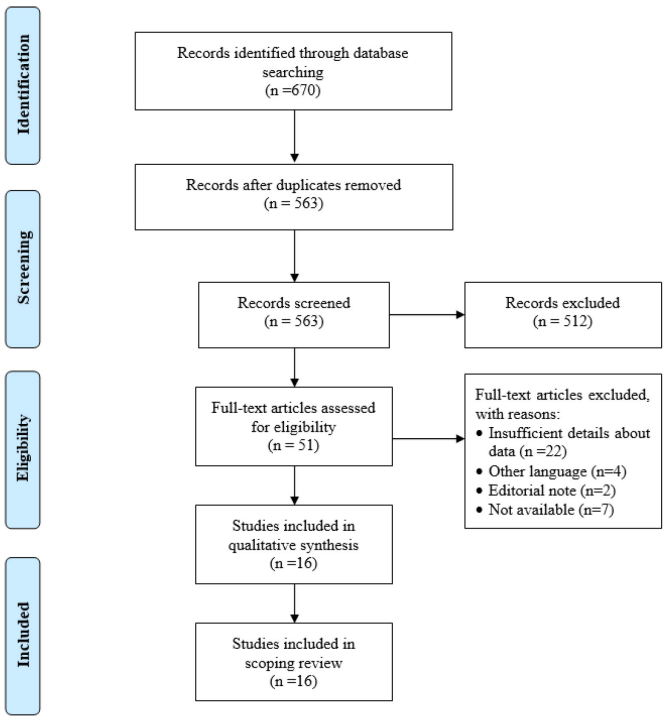
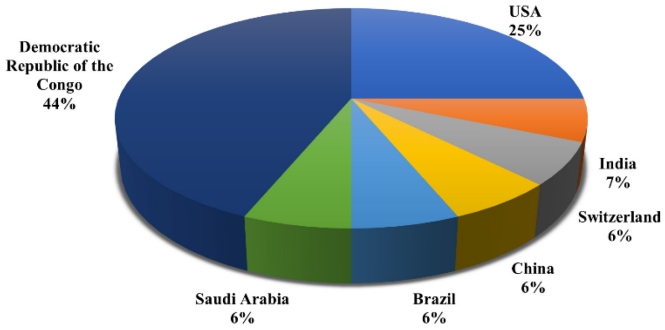


Figure 2. The Frequency percentage of included studies based on country.



Result

Search Results

From all three databases (PubMed, Scopus, and Web of Science), 670 articles were retrieved. After excluding 107 duplicates, 563 studies were left for screening by title and abstract. Following this, 63 full-text articles were assessed for eligibility. Eventually, 16 studies met the inclusion criteria and were included for final analysis. The characteristics of 16 included articles are summarized in Table 2. An additional 3 studies were identified through grey literature sources. Extracted data from World Health Organization (WHO) [36], Pan American Health Organization (PAHO) [37], and the Centers for Disease Control and Prevention (CDC) [38] Websites were added to this study as complementary evidence to enrich the study. Figure 1 illustrates the detailed screening and selection process based on to the PRISMA-ScR flow diagram.

Characteristics of Source Evidence

The studies listed were published from 1998 to 2023 and therefore encompass both early and recent work on Mpox and relevant data reporting systems. A geographical clustering of studies was seen in the DRC, where 44% (7 out of 16) of all included publications came from.

Table 2. Characteristics of the Selected Articles.

First Author	Year	Country	Purpose of Study
Assiri A. M. [1]	2023	Saudi Arabia	To describe clinical features and outcome of human Mpox of the first cases
Bass J. [2]	2013	DRC	Enhance the ability of healthcare workers to diagnose and care for patients with monkeypox.
Doshi R. H. [3]	2019	DRC	The investigation and analysis epidemiological and ecological aspects of human monkeypox cases reported during January–April 2017
Dumont C. [4]	2014	DRC	Using the outbreak of monkeypox and chickenpox in DRC as a test case to develop a rapid and specific diagnosis tool in remote areas.
Dyall J. [5]	2017	USA	Investigation of [18F]-FDG-PET/CT imaging of immune processes in lymphoid tissues to identify biomarker of monkeypox survival/fatality.
Fleischauer A. T. [6]	2005	India	Investigate the exposure of healthcare workers (HCWs) to confirmed cases of monkeypox.
Huhn G. D. [7]	2005	USA	Examining clinical and laboratory characteristics of confirmed cases of human monkeypox infection in adults and children in the United States
Jezek Z. [8]	1988	DRC	Presenting the extent of and reasons for the errors in diagnosing human monkeypox from chickenpox.
Laurenson-Schafer H. [9]	2023	Switzerland	To describe the global epidemiology of Mpox cases reported to WHO by Member States through the global surveillance system.
Martins-Filho P. R. [10]	2023	Brazil	To describes the incidence rates, geographic distribution, and clinical characteristics of monkeypox in Brazil.
Nalca A. [11]	2005	USA	Reviewing the current state of knowledge about human monkeypox with emphasis on epidemiological features, clinical features, diagnosis, treatment and prevention.
Osadebe L. [12]	2017	DRC	Examine specific clinical features related to laboratory-confirmed cases of monkeypox in humans
Quiner C. A. [13]	2017	DRC	Describing common behaviors and practices surrounding fulfilling nutritional requirements in monkeypox patients.
Rajeh A. [14]	2021	USA	Study the iCAT (Immunologic History Assessment Tool using High-throughput T-cell Receptor Sequencing) for diagnostic evaluation
Rimoin A. [15]	2010	DRC	Conduct active surveillance of monkeypox from 2005 to 2007 in healthcare zones
Zong Y. [16]	2023	China	To describe the characteristics of early cases in Guangdong Province and analyze the current situation of the outbreak.

1. Assiri AM, Al-Tawfiq JA, Jokhdar HA, Algwizani AR, Albarraq AM, Alanazi KH, Alamri AH, Almohammadi EL, Abuhasan MY, Alserehi HA (2023) Clinical features and outcome of human Mpox (Monkeypox) in Saudi Arabia: An observational study of travel-related cases. J Infect Public Health 16:341-345.
2. Bass J, Tack DM, Mccollum AM, Kabamba J, Pakuta E, Malekani J, Nguete B, Monroe BP, Doty JB, Karhemere S, Damon IK, Balilo M, Okitolonda E, Shongo RL, Reynolds MG (2013) Enhancing health care worker ability to detect and care for patients with monkeypox in the Democratic Republic of the Congo. Int Health 5:237-243.
3. Doshi RH, Guagliardo SaJ, Doty JB, Babeaux AD, Matheny A, Burgado J, Townsend MB, Morgan CN, Satheshkumar PS, Ndakala N, Kanjingankolo T, Kitembo L, Malekani J, Kalemba L, Pukuta E, N'kaya T, Kangoula F, Moses C, Mccollum AM, Reynolds MG, Mombouli JV, Nakazawa Y, Petersen BW (2019) Epidemiologic and Ecologic Investigations of Monkeypox, Likouala Department, Republic of the Congo, 2017. Emerg Infect Dis 25:281-289.
4. Dumont C, Irenge LM, Magazani EK, Garin D, Muyembe JJT, Bentahir M, Gala JL (2014) Simple Technique for in Field Samples Collection in the Cases of Skin Rash Illness and Subsequent PCR Detection of Orthopoxviruses and Varicella Zoster Virus. PloS One 9.
5. Dyall J, Johnson RF, Chefer S, Leyson C, Thomasson D, Seidel J, Ragland DR, Byrum R, Jett C, Cann JA, St Claire M, Jagoda E, Reba RC, Hammoud D, Blaney JE, Jahrling PB (2017) [(18)F]-Fluorodeoxyglucose Uptake in Lymphoid Tissue Serves as a Predictor of Disease Outcome in the Nonhuman Primate Model of Monkeypox Virus Infection. J Virol 91:e00897-00817.
6. Fleischauer AT, Kile JC, Davidson M, Fischer M, Karem KL, Teclaw R, Messersmith H, Pontones P, Beard BA, Braden ZH, Cono J, Sejvar JJ, Khan AS, Damon I, Kuehnert MJ (2005) Evaluation of human-to-human transmission of monkeypox from infected patients to health care workers. Clin Infect Dis 40:689-694.
7. Huhn GD, Bauer AM, Yorita K, Graham MB, Sejvar J, Likos A, Damon IK, Reynolds MG, Kuehnert MJ (2005) Clinical characteristics of human monkeypox, and risk factors for severe disease. Clin Infect Dis 41:1742-1751.
8. Jezek Z, Szczeniowski M, Paluku KM, Mutombo M, Grab B (1988) Human monkeypox: confusion with chickenpox. Acta Trop 45:297-307.
9. Laurenson-Schafer H, Sklenovská N, Hoxha A, Kerr SM, Ndumbi P, Fitzner J, Almiron M, De Sousa LA, Briand S, Cenciarelli O (2023) Description of the first global outbreak of mpox: an analysis of global surveillance data. Lancet Glob Health 11:e1012-e1023.
10. Martins-Filho PR, Nicolino RR, Da Silva K (2023) Incidence, geographic distribution, clinical characteristics, and socioeconomic and demographic determinants of monkeypox in Brazil: A nationwide population-based ecological study. Travel Med. Infect. Dis. 52:102517.
11. Nalca A, Rimoin AW, Bavari S, Whitehouse CA (2005) Reemergence of monkeypox: prevalence, diagnostics, and countermeasures. Clin Infect Dis 41:1765-1771.
12. Osadebe L, Hughes CM, Lushima RS, Kabamba J, Nguete B, Malekani J, Pukuta E, Karhemere S, Tamfum JJM, Okitolonda EW, Reynolds MG, Mccollum AM (2017) Enhancing case definitions for surveillance of human monkeypox in the Democratic Republic of Congo. PLoS Negl. Trop. Dis. 11
13. Quiner CA, Moses C, Monroe BP, Nakazawa Y, Doty JB, Hughes CM, Mccollum AM, Ibata S, Malekani J, Okitolonda E, Carroll DS, Reynolds MG (2017) Presumptive risk factors for monkeypox in rural communities in the Democratic Republic of the Congo. PLoS One 12:e0168664.
14. Rajeh A, Wolf K, Schiebout C, Sait N, Kosfeld T, Dipaolo RJ, Ahn TH (2021) iCAT: diagnostic assessment tool of immunological history using high-throughput T-cell receptor sequencing. F1000Res 10:65.
15. Rimoin AW, Mulembakani PM, Johnston SC, Lloyd-Smith JO, Kisalu NK, Kinkela TL, Blumberg S, Thomassen HA, Pike BL, Fair JN, Wolfe ND, Shongo RL, Graham BS, Formenty P, Okitolonda E, Hensley LE, Meyer H, Wright LL, Muyembe JJ (2010) Major increase in human monkeypox incidence 30 years after smallpox vaccination campaigns cease in the Democratic Republic of Congo. Proc. Natl. Acad. Sci. U. S. A. 107:16262-16267.
16. Zong Y, Yang Y, Kong D, Xu J, Liang Z, Shi F, Huang J, Kang M, Zhong H, Liang W (2023) Epidemiology and characteristics of identified early mpox cases in Guangdong Province, China: Implications for prevention and control. Biosaf Health 5:321-325.

Other studies were majorly done in the USA, India, Saudi Arabia, Brazil, China, and Switzerland. Figure 2 and Figure 3 show the distribution of studies across countries and by year of publication, respectively.

Classification of the Data Elements

From 16 syntheses and institutional datasets, a comprehensive data set of 104 unique data elements emerged. These data elements were divided into two areas: administrative and clinical, having 38 core data elements and 66 extenders. The administrative data were essentially divided into four broad categories: demographic data, socioeconomic data, residential address data, and healthcare center/provider data. This domain encompassed 25 data elements, of which 10 were regarded as core and 15 were classified as extended. The Clinical Data domain is wider,

Figure 3. The distribution of included studies based on publication years.

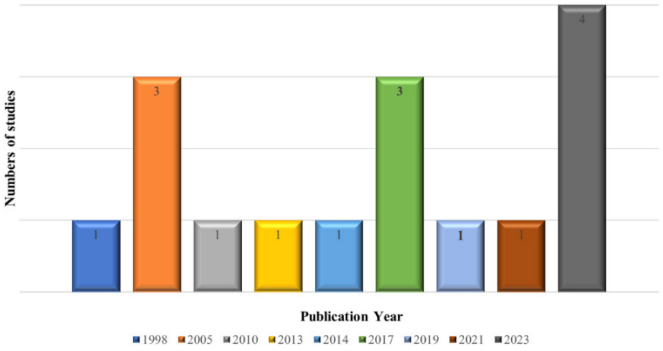


Table 3. Comprehensive data set for Monkeypox Disease.

Administrative Data			
Main category		**Core data elements**	**Extended data elements**
Demographic data		national ID, gender, date of birth/age, nationality	name, last name, father's name, race, blood type and Rh
Socioeconomic data		-	occupation, marital status, educational degree, ethnicity
Residential address data		Country, province, city/village	full residence address, telephone, mobile phone number, email address
Healthcare centers/providers' data		healthcare center name, visit type, referral date	healthcare center type, service provider specialist
Clinical Data			
Main category	**Subcategory**	**Core data elements**	**Extended data elements**
Disease exposure	Direct	suspected individual, infected individual, infected animal	contaminated environments
	Travel History (in the past 21 days)	country, city, date of return	
Signs and Symptoms of Disease	Vital signs	body temperature	blood pressure, heart rate, respiratory rate
	General Symptoms	fever, swollen lymph nodes, muscle aches, fatigue, headache	chills, backache, dry mouth
	Skin Symptoms (rashes, peeling, etc.)	hands, feet, face, genital system (penis, testicles, labia, and vagina), anus	chest, mouth, ears, eyes
	Respiratory Symptoms	dyspnea	sore throat, nasal congestion, cough
	Never Symptoms	-	encephalitis, myelitis, altered consciousness, anorexia
Personal and Family Medical History Data	Anthropometrics	-	Hight, Weight
	Personal Medical History	-	underlying diseases (yes or no), underlying disease name, underlying disease duration, provided treatment
	Family History of Smallpox	-	family relative, onset date of disease
	Alcohol and Substance Abuse History	-	smoking, hookah, alcohol, addictive drugs
	Current medications	-	drug name, drug dose, duration of drug use
Diagnostic procedures	Laboratory test data	PCR test, serological tests (IGM & IGG),	urine culture, stool culture, blood culture, immunofluorescence antibody assay (IFA)
	Biopsy or sampling data		vesicular fluid, skin tissue
	Other diagnostic procedures	-	procedure name, procedure date
Treatment procedure	Medication data	Tecovirimat (TPOXX, ST-246), Cidofovir, Brin cidofovir	other drugs
	Surgical/invasive procedures data	-	operation name, operation date
	Other procedure	-	procedure name, procedure date
Treatment Follow-up and Outcome	Disease Progression and Treatment Response	discharge status (for hospitalized patients), final treatment outcome	evaluation/ follow-up date, evaluation result, duration of stay (for hospitalized patients)
Vaccination	Vaccine Type	JYNNEOS vaccine, ACAM2000, smallpox vaccine	other vaccines, vaccination date

presenting seven main types: disease exposure data, disease signs and symptoms, personal and family medical history, diagnostic procedures, treatment procedures, treatment follow-up and outcomes, and vaccination data, with 20 subcategories. This domain is made up of 28 core data elements and 51 extended data elements. Table 3 gives full details of the different categories and their core and extended data elements. This hierarchy guarantees that core data elements would have to include essential information needed for case registration, surveillance, and clinical documentation only. In contrast, the extended data elements include additional variables added to provide further aspects necessary for epidemiological research, health management, and outcome evaluation.

Discussion

The development of a data set for Mpox represents a significant step forward in addressing the global challenges posed by this emerging infectious disease. In this research, 104 data elements were identified in 38 core data elements and 66 extended data elements. 104 data elements were identified in 38 core data elements and 66 extended data elements. The proposed data set is divided into administrative and clinical data categories, addressing the need for operational efficiency while providing thorough clinical insights into disease management. Similar studies that have identified MDSs for different diseases have been divided into administrative and clinical data [23,34,39].

A key strength of this data set is its emphasis on disease exposure data, enabling a deeper understanding of transmission dynamics, which is critical for developing effective containment strategies. This focus is well supported by Guarducci *et al.*, who emphasized that precise case definitions with detailed contact history are critical for effective contact tracing and for breaking chains of transmission [19]. In the clinical category, the disease exposure class includes data elements for direct, indirect, and travel history (within the past 21 days). This focus aligns with findings from Malik *et al*., whose research on Mpox prevention and treatment highlights the importance of vaccination and risk factor avoidance as primary preventive measures. Their study highlights the importance of avoiding direct contact with humans and animals that might carry Mpox, refraining from handling objects contaminated by infected animals, and minimizing interactions with individuals who are suspected or confirmed to have Mpox [40].

Vital signs, general symptoms, skin symptoms (rashes, peeling, etc.), respiratory symptoms, and neurological symptoms were all covered in the data set's lesson on signs and symptoms. Skin lesions, fever, and lymphadenopathy were the most prevalent symptoms in the research by Liu *et al.*, which used a systematic review and meta-analysis to identify the clinical aspects of illness. Also, the study emphasized the average age of patients, gender, and sexual relations [41]. The inclusion of specific skin abnormalities is essential to account for the novel clinical presentations noted in the 2022 outbreak, one of which is the frequent localized anogenital rash, setting it apart from historic Mpox presentations [20]. These data elements are present in the demographic data subclass in our study. This alignment ensures the proposed data set captures the most relevant clinical indicators for effective disease management.

Various molecular, phenotypic, immunological, and electron microscopy methods are used to diagnose Mpox [13]. Atceken *et al.* stated that developing accurate and quick diagnostic methods is crucial for facilitating early detection and efficient monitoring of infectious diseases, including human Mpox [42]. Because of the important role of diagnostic tests in the Mpox management, a separate class is dedicated to diagnostic procedures in the proposed data set. This section encompasses a range of diagnostic tests based on the disease's nature and expert recommendations. Three primary classes for the clinical diagnostic test results group were to record laboratory, cardiology diagnostic, and abnormal medical imaging tests in patients with COVID-19, according to the research by Zarei *et al*., which provided a minimal data set of the COVID-19 registry system [23]. Comparing the Proposed Mpox data set with the existing standards laid down by other high-priority pathogens clearly defines serious contextual choices and limitations to generalizing. For example, in the MDS for COVID-19 [23], respiratory function and imaging were the top priorities, while the Mpox data set focuses much more on detailed lesion characteristics and more comprehensive exposure history, in the same way, very comprehensive behavioral and social factors are collected in existing MDS for HIV care and STIs [10,20]. This tailor-made approach ensures that the data collected will be relevant to a profile of unique clinical presentation and changing routes of transmission that are specific to Mpox, thereby giving it a more focused standard rather than generalized public health data sets [19]. Several pharmacological and non-pharmacological interventions have been proposed for Mpox. Mainly, pharmacological treatments using different techniques, such as inhibiting viral

polymerase or preventing the release of new viruses from the cell, have shown promising results [40]. However, in terms of the many side effects of this disease, there may be a need to use other treatment methods, as well as the need to monitor patients closely [43]. Based on this, the proposed data set in this study includes the treatment follow-up and outcome class, in addition to the treatment process section that provides the possibility of recording treatment data. The separate section for patient follow-up data is a novel inclusion that can significantly enhance long-term disease management and outcome analysis. Tierney *et al.* have developed an MDS for HIV care in developing countries, emphasizing a need for data elements about treatment adherence and outcomes [25] that align with the necessity of tracking long-term sequelae and treatment efficacy, particularly for immunocompromised individuals, where data collection remains a challenge [2].

The importance of vaccination is very high, especially in critical situations for viral diseases. The infection of large populations worldwide has raised concerns about our preparedness against this emerging viral pathogen [44]. The results of Mason *et al.* study highlighted the efficacy of one or two doses of MVA-BN during a multi-country outbreak for Mpox infection [45]. Given the critical role of vaccination in Mpox control, the dedicated section on vaccination data in the data set is a new feature that sets it apart from many other datasets. The incorporation of vaccination and particular exposure details straightforwardly aids public health measures such as the focused vaccination campaigns and systematic STI screening that have allowed the effective containment [20] in Spain.

Using a standardized data set, public health authorities can more effectively monitor the spread of Mpox, identify outbreaks early, and implement timely interventions [46]. Nonetheless, a key limitation of this research was the absence of access to infectious disease specialists with experience in direct interactions with patients affected by Mpox. On the other hand, due to the changeable nature of virus, its possible genetic rearrangement, the possibility of the emergence of new strains, and the change in the virus's behavior, there is a possibility of a change in the form of the disease [47]. Also, if care protocols change and additional tests and treatments become available to patients, there is a need to review the dataset. The intention to integrate the data set with existing health information systems for real-time data utilization is a forward-looking aspect that underscores the dataset's practical applicability.

Strengths and Limitations of the Study

This is the first comprehensive effort to systematically develop a database for Mpox based on existing literature. This fills a critical gap in standardized data collection tools for effective epidemic response. Through the scope of the review, it has successfully identified and classified a wide range of key data elements, providing a robust baseline for defining core data requirements in diverse healthcare settings. However, despite such strong conceptual and practical foundations, limitations pertaining to this study require future global efforts of implementation. A geographic bias is present within the evidence base, with two-thirds of the studies being carried out in the Democratic Republic of the Congo (DRC) and the remaining one-third in the USA [48]. This geographical bias constitutes a substantial challenge for the global generalization of the data set, as the public health infrastructure, laboratory capacities, and digital reporting systems in the DRC, being endemic and resource-constrained, are vastly different from those employed in high-income countries that experienced large outbreaks in 2022, such as Spain or the USA [10]. By contrast, the practical feasibility of collecting large, granular clinical datasets may be more inherently limited in the DRC than in the USA. Hence, the collection of all 105 data elements, especially complex clinical and laboratory data, may not be uniformly feasible across various settings. This inherent bias must be stated transparently, and subsequent endeavors should be devoted to validating and possibly modifying a core subset of this data set according to the regions' operational capacities in the interest of universal applicability across varied resource settings. Subsequently, with the establishment of this baseline dataset through a scoping review combined with a consensus-based approach, the next critical step involves collection of prospective validation information from targeted consultation of key international stakeholders. This, as per the last stage of the Arksey and O'Malley framework, would be imperative for transitioning the dataset from a scientific model into one that is feasible, acceptable, and practically useful to end-users who have real experiences in real-time outbreak management. Furthermore, the validation process makes it possible to ensure that the dataset is compliant with the various operational realities and epidemiological contexts found globally.

Conclusions

Identifying this data set is crucial to improving

public health responses to Mpox outbreaks. It will enable healthcare professionals and researchers to monitor the disease more effectively, contribute to developing targeted interventions, and ultimately, aid in controlling and preventing Mpox globally. Future research should aim to validate the data set across different settings, adapt it to the disease's evolving nature, and integrate it with existing health information systems to facilitate real-time data utilization The fight against emerging infectious diseases like Mpox requires robust data infrastructure, and this data set is a testament to the power of comprehensive data in guiding public health initiatives.

Authors' contributions

SP and AS conceived and designed the study. FB and FB collected the data. SP analyzed the data and created the figures and tables with consultation from AS and LA. SP, HE, and AS drafted the manuscript, and all authors reviewed the manuscript and approved the final version for submission.

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Conflict of interest

No conflict of interest is declared.

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