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RESEARCH ARTICLE

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Evaluation of mpox contact tracing activities and data collection in EU/EEA countries during the 2022 multicountry outbreak in nonendemic countries

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Abstract

To control human-to-human mpox transmission during the 2022 outbreak, European Union (EU)/European Economic Area (EEA) countries conducted case investigation and contact tracing (CT). We aimed to provide an overview of CT activities, describe CT data collection practices, and identify related facilitators, barriers, and potential opportunities for improvement. Between April 03, 2023 and May 12, 2023, a survey was distributed to CT stakeholders in 30 EU/EEA countries, asking about mpox CT activities and data collection and requesting to rank enablers, barriers, and improvements for CT on a five-point Likert scale. The 139 respondents from 27 countries indicated having performed case investigations (96%, $n = 133$), backward CT (88%, $n = 122$), forward CT (87%, $n = 121$), and follow-up on contacts' outcomes (77%, $n = 107$). Sixty percent ($n = 80/134$) used standardized data collection forms and 73% ($n = 91/124$) used databases. The highest-rated enablers were clear guidelines (mean = 3.9), quick access to laboratory results (3.6), and sufficient expertise (3.6). Highly rated barriers were inability to contact contacts (3.0) or cases (2.5) and lack of staff (2.4). The most needed improvements were availability of staff (3.5), expertise on affected populations (3.4) and data reporting tools and systems (3.3). To improve CT of mpox and diseases with similar transmission patterns, EU/EEA countries should increase workforce capacity in public and sexual health, offer training on CT operations and communication with affected communities, and use common CT data collection tools and systems.

KEYWORDS
data collection, epidemiological surveillance, EU/EEA, mpox outbreaks, public health authorities

Henrieke Prins and Liza Coyer shared the first authorship and Daniel Cauchi and Agoritsa Baka shared the last authorship.

1 | INTRODUCTION

Since the first detection of mpox in humans in 1970, most cases occurred in Central and West Africa with rare, sporadic cases reported elsewhere.[1] However, on May 7, 2022, the United Kingdom notified the first case of mpox of the 2022 outbreak[2] to the World Health Organization (WHO). On July 23, 2022, the WHO Director-General declared the multicountry mpox outbreak a Public Health Emergency of International Concern.[3] This status was subsequently lifted on May 11, 2023.[4] As of late August 2023, approximately 26 000 cases have been identified in 45 countries and areas within the WHO European Region in relation to the 2022 outbreak.[5]

The legally binding International Health Regulations (IHR) 2005 require countries to have the ability to detect, report, and respond to infectious health threats.[6] Contact tracing is one of the tools used to control infectious disease outbreaks like mpox.[7-10] Its purpose is to identify and isolate new cases to interrupt transmission chains. Moreover, persons who have been exposed to a case or are likely to be exposed in the future based on risk factors can be identified through contact tracing and offered prevention strategies, such as risk reduction counseling, vaccination, and postexposure prophylaxis.[8,11,12] Specifically, uniform collection of contact tracing data during multi-country infectious disease outbreaks enables aggregated analyses on important transmission indicators including transmission chains, secondary attack rates, and attack rates by type of contact.[12] Such analyses promote an understanding of disease dynamics and can inform isolation and contact tracing recommendations and policies, including non-stigmatizing methods for community engagement. To facilitate case investigation and contact tracing of mpox, and to harmonize the collection of relevant epidemiological data, the European Centre for Disease Prevention and Control (ECDC) and WHO provided guidance documents, case investigation, and case report form templates, the first of which were published on June 24, 2022.[13,14] Several national public health agencies also developed their own guidelines and mpox case investigation and contact tracing forms.[15-22]

There are several factors that potentially challenge the implementation of mpox contact tracing and the aggregation of data. First, there is a general lack of policy and legal instruments to apply IHR,[23] including no legal obligation to perform contact tracing. Second, mpox only became notifiable in some countries in the European Union (EU)/European Economic Area (EEA) during the 2022 outbreak. In addition, case definitions and indications differed between the WHO, ECDC, and several EU/EEA countries.[24] Third, empirical data to inform best practices for contract tracing are scarce and countries do not always possess adequate capacity and expertise to perform contact tracing.[7] Fourth and last, specific contact tracing activities varied according to countries' national and regional regulations and recommendations.

An informal evaluation of unpublished data provided by 11 EU/EEA countries at the end of 2022 suggested heterogeneity of contact tracing procedures and corresponding forms used, and challenges with obtaining and pooling corresponding data. However, to our knowledge, no multicountry overview of mpox contact tracing activities conducted during the 2022 multi-country outbreak has been published, nor has there been a systematic evaluation of stakeholder experiences or of data collected through contact tracing. The aim of this study was to provide an overview of which EU/EEA countries conducted mpox contact tracing activities, to describe contact tracing data collection practices across and within countries at different levels (i.e., national, regional, local), and to identify related facilitators, barriers, and potential improvements. To do so, a convenience sample was obtained by distributing a survey to ECDC's National Focal Points (NFPs) for Preparedness and Response, who were asked to forward the survey to stakeholders performing mpox contact tracing activities in their respective countries.

2 | METHODS

2.1 | Questionnaire content and development

A web-based, anonymous questionnaire was developed with 54, primarily multiple-choice, questions on contact tracing activities, data collection, and experiences. Questions included which country respondents were from, what type of institute or organization they worked at (i.e., government, public health institute, sexual health clinic, hospital) and at which level (i.e., national, regional, local). With respect to contact tracing activities, it contained questions about the specific activities performed (i.e., case investigation, backward contact tracing, forward contact tracing including identification of contacts, contacting of contacts, follow-up of contacts on disease status) and reason for not performing backward contact tracing. With respect to contact tracing data collection, the survey asked questions on guidelines and forms used, and data collection methods (i.e., use of a database, which database, level of use, reason for not using a database, and method of collecting data including wide and long format). With respect to contact tracing experiences, several potential facilitators and barriers to contact tracing during the mpox outbreak in 2022 were listed, as well as possible improvements the respondent might consider necessary in the context of contact tracing activities of sexually transmitted diseases. Respondents were asked to rank the extent to which each facilitator and barrier affected contact tracing activities according to a five-point Likert scale (ranging from 1 “to no extent” to 5 “to a very large extent” for facilitators and barriers). Similarly, a five-point Likert scale ranging from 1 “strongly disagree” to 5 “strongly agree” was used for potential improvements. Respondents could add and rank additional factors that were not listed in free text boxes. No questions were obligatory. The questionnaire is provided in the Appendix S3.

2.2 | Procedures

The survey was designed and distributed using REDCap,[25] a survey tool that is securely hosted on ECDC servers. As no list exists of all institutes, organizations, or individuals performing contact tracing in each EU/EEA country, a convenience sample strategy was chosen. The survey was sent to all ECDC NFPs for Preparedness and Response using secure links via email. In the invitation, NFPs were asked to distribute the survey within their country to health professionals performing mpox contact tracing at the national, regional, and local level, including those working at public health institutes, government organizations, and sexual health clinics, if

applicable. The survey ran between April 3 and May 12, 2023. One general reminder was sent on May 5, 2023, and individual reminders were sent to NFPs of countries without any responses.

Since the survey did not collect any private or personal data on mpox cases or on individual respondents, and was undertaken for surveillance and public health management purposes, ethical approval was not required.

2.3 | Analysis

A descriptive analysis was conducted, starting with the total number of survey respondents per country, the type of institute or organization at which they worked, and whether respondents worked at the national, regional, or local level. This was followed by a description of the different contact tracing activities that were performed during the 2022 mpox outbreak, and which methods respondents used to collect data. The relative importance of each facilitator, barrier, and improvement was assessed according to the mean score based on the 1–5 Likert scale. Considering the possibility of multiple respondents per country, reported outcomes were stratified by country and level to explore differences. Bar graphs were created to visualize the distribution of responses for each facilitator, barrier, and improvement. For data cleaning, further analysis, and visualization, R version 4.0.2 (Vienna, Austria) was used. Appendix S1, Section 2 lists the R packages that were used.

3 | RESULTS

3.1 | Survey respondents

In total, 139 respondents from 27 EU/EEA countries completed the questionnaire. Table I of Appendix S3, describes all responses per country and level or organization. Germany ($n = 68$), Spain ($n = 20$) and Austria ($n = 14$) provided most responses (Table 1). There were no responses from Luxembourg, Slovak Republic and Poland. There were seven responses from Norway, whereas between one and three responses were obtained from the remaining 23 EU/EEA countries: Belgium, Bulgaria, Croatia, Cyprus, Czechia, Denmark, Estonia, Finland, France, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Liechtenstein, Malta, Norway, Portugal, Romania, Slovenia, Sweden, and The Netherlands (Appendix S3).

Of 138 respondents who indicated the type and level of organization at which they were employed, most worked at a public health agency ($n = 81$, 59%), or at a governmental organization ($n = 41$, 30%). Respondents most commonly worked at the regional ($n = 55$, 40%) or at the local level ($n = 57$, 41%). A substantial number of responses at the local level were from Germany ($n = 45$, 79%), in comparison to Spain ($n = 1$, 2%) and Austria ($n = 4$, 7%).

3.2 | Contact tracing activities

The majority of the 139 respondents indicated that their organization performed contact tracing activities (total excluding missing data): 96% ($n = 133$) reported having conducted case investigation, 88% ($n = 122$) backward contact tracing, 90% ($n = 121$) forward contact tracing, and 78% ($n = 107$) reported performing follow-up on contact outcomes (Table 1). All countries listed at least one of the four activities. Specific activities per country are provided in Table I of the Appendix S3. Results were similar for Germany, Spain, and Austria, although forward contact tracing and follow-up on contact outcomes were performed less often in other countries than in these countries. The four listed contact tracing activities were indicated by at least 75% of respondents in each of these three countries, with Spain having the highest proportion of respondents performing all listed activities.

3.3 | Contact tracing data collection

Of 134 respondents answering this question, 60% ($n = 80$) reported using a standardized form for contact tracing. If a standardized form was used, excluding forms provided by their own country, respondents most often used ECDC guidance ($n = 31/80$, 39%), followed by WHO guidance ($n = 18/80$, 23%). The single respondent from Liechtenstein at the national level mentioned that they used a template from Switzerland. Among those providing information, 53% ($n = 34/64$) respondents in Germany, 55% ($n = 11/20$) in Spain, and 69% ($n = 9/13$) in Austria used a standardized form.

Of 124 respondents with information on their database, 73% ($n = 91$) recorded contact tracing data into a database and 27% ($n = 33$) did not. Tools that were listed included Go.Data,[26] SORMAS,[27] EMS,[28] Excel, Word, or local data collection software (i.e., mostly software routinely used in the German infectious disease surveillance system, such as SurvNet@RKI[29]). Of the 33 respondents not recording contact tracing data into a database, the most commonly reported reasons for not doing so (multiple options could be chosen) were: absence of a clear form/template ($n = 9$, 27%), inadequate data infrastructure ($n = 7$, 21%), too few cases ($n = 6$, 18%) and lack of expertise ($n = 4$, 12%). 63% ($n = 43/68$) of respondents in Germany, 80% ($n = 16/20$) in Spain, and 71% ($n = 10/14$) in Austria indicated recording contact tracing data into a database.

Among 91 respondents who recorded contact tracing in a database, 88 provided information on their database structure. Of these, 36% ($n = 32$) had separate databases for cases and contacts. When asked about how forward contact tracing data were recorded in their database, 73% ($n = 66/91$) respondents recorded information on forward contacts who acquired mpox in the original case's record and 40% ($n = 36/91$) recorded information on forward contacts who did not acquire mpox in the original case's record. Of 89 respondents providing this information, 57% ($n = 51$) recorded forward contacts separately as cases (i.e., created a new record) and could link these to the original case with an identifier.

3.4 | Facilitators, barriers, and improvements to contact tracing

Table 2 lists the facilitators, barriers, and improvements receiving the highest scores across all respondents and for respondents in the countries with 10 or more responses. Facilitators considered to be

TABLE 1 Characteristics of survey respondents and mpox contact tracing activities performed in 27 EU/EEA countries during the 2022 multicountry outbreak: overall and separately for Germany, Spain, and Austria.

Country	Mpox cases[a]	Survey responses	Type of organization	Level of organization	Performed contact tracing activities			
					Case investigation (*n*/*N*, %)	Backward contact tracing (*n*/*N*, %)	Forward contact tracing (*n*/*N*, %)	Follow-up contact outcomes (*n*/*N*, %)
Total (27 countries)	26 001	*139*	Government (*n* = 41) Public health institute (*n* = 81) Sexual health clinic (*n* = 2) Hospital (*n* = 1) Other (*n* = 13) Missing (*n* = 1)	National (*n* = 24) Regional (*n* = 55) Local (*n* = 57) Other (*n* = 2) Missing (*n* = 1)	133/139, 96%	122/139, 88%	121/135,[b] 90%	107/138*, 78%
Germany	3694	68	Government (*n* = 13) Public health institute (*n* = 48) Sexual health clinic (*n* = 1) Other (*n* = 5) Missing (*n* = 1)	National (*n* = 1) Regional (*n* = 21) Local (*n* = 45) Missing (*n* = 1)	63/68, 93%	57/68, 84%	58/66†, 88%	51/68, 75%
Spain	7565	20	Government (n = 9) Public health institute (n = 10) Other (n = 1)	National (*n* = 1) Regional (*n* = 18) Local (*n* = 1)	20/20, 100%	19/20, 95%	17/19‡, 89%	18/20, 90%
Austria	328	14	Government (n = 10) Public health institute (n = 4)	National (*n* = 2) Regional (*n* = 8) Local (*n* = 4)	13/14, 93%	11/14, 79%	11/13$, 85%	11/14, 79%
Total without Germany, Spain, Austria (24 countries)	9446	37	Government (n = 9) Public health institute (n = 19) Sexual health clinic (n = 1) Other (n = 8)	National (*n* = 20) Regional (*n* = 8) Local (*n* = 7) Other (*n* = 2)	37/37, 100%	35/37, 95%	35/37, 70%	26/37, 70%

Note: Number of responses from other countries (in alphabetical order): Belgium (*n* = 3), Bulgaria (*n* = 1), Croatia (*n* = 1), Cyprus (*n* = 1), Czechia (*n* = 1), Denmark (*n* = 1), Estonia (*n* = 1), Finland (*n* = 1), France (*n* = 1), Greece (*n* = 1), Hungary (*n* = 1), Iceland (*n* = 2), Ireland (*n* = 2), Italy (*n* = 1), Latvia (*n* = 1), Liechtenstein (*n* = 1), Malta (*n* = 1), Norway (*n* = 7), Portugal (*n* = 1), Romania (*n* = 1), Slovenia (*n* = 3), Sweden (*n* = 2), The Netherlands (*n* = 1).

[a]Number of cases of mpox as of August 30, 2023, identified through International Health Regulation mechanisms and official public sources and reported to TESSy, European Region, 2022–2023.[5]

[b]Four missing responses, *1 missing response, †2 missing responses, ‡1 missing response, $1 missing response.

TABLE 2 Highest rated contact tracing facilitators, barriers, and improvements in 27 EU/EEA countries during the 2022 multi-country outbreak, based on mean Likert score[a] ratings overall and stratified by Germany, Spain, Austria, and responses from other countries.

Overall (n = 139)		Germany (n = 68)		Spain (n = 20)		Austria (n = 14)		Other countries (n = 36)	
Facilitators	**Mean (1–5)**	**Facilitators**	**Mean (1–5)**	**Facilitators**	**Mean (1–5)**	**Facilitators**	**Mean (1–5)**	**Facilitators**	**Mean (1–5)**
Sufficiently clear guidelines	3.9	Sufficiently clear guidelines	3.7	Sufficiently clear guidelines	4.1	Sufficiently clear guidelines	4.0	Sufficiently clear guidelines	4.1
Quick access to lab results	3.6	Quick access to lab results	3.4	Quick access to lab results	3.9	Adequate system to collect data	4.0	Quick access to lab results	3.9
Sufficient expertise	3.6	Sufficient expertise	3.4	Sufficient expertise	3.6	Sufficient expertise	3.8	Sufficient expertise	3.9
		Good collaboration with stakeholders	3.4			Sufficient staff	3.8		
Barriers	**Mean**	**Barriers**	**Mean**	**Barriers**	**Mean**	**Barriers**	**Mean**	**Barriers**	**Mean**
Inability to contact contacts of cases	3.0	Inability to contact contacts of cases	3.0	Inability to contact contacts of cases	3.5	Lack of time	3.3	Inability to contact contacts of cases	2.8
Inability to contact cases	2.5	Delay in reporting of lab results	2.5	Lack of staff	3.2	Inability to contact contacts of cases	3.1	Inability to contact cases	2.4
Lack of staff	2.4	Inability to contact cases	2.4	Inability to contact cases	2.9	Lack of staff	2.9	Lack of staff	2.2
Lack of time	2.4			Lack of time	2.9				
				Lack of an adequate system to collect/exchange data	2.9				
Improvements	**Mean**	**Improvements**	**Mean**	**Improvements**	**Mean**	**Improvements**	**Mean**	**Improvements**	**Mean**
Availability of staff	3.5	Availability of staff	3.6	Expertise on affected populations including their sexual health behaviors	3.5	Expertise on affected populations including their sexual health behaviors	3.8	Expertise on affected populations including their sexual health behaviors	3.5
Expertise on affected populations including their sexual health behaviors	3.4	Availability of data reporting tools and/or templates	3.4	Availability of staff	3.4	Better communication with community stakeholders	3.8	Availability of staff	3.3
Availability of an adequate system to collect and/or exchange data	3.3	Availability of an adequate system to collect and/or exchange data	3.4	Better collaboration with other stakeholders on contact tracing	3.4	Availability of staff	3.7	Availability of data reporting tools and/or templates	3.3
More time allocated to contact tracing	3.3	Availability of clear guidelines on contact tracing	3.4					Training on how to communicate with affected populations	3.3
Better communication with community stakeholders	3.3								
Availability of data reporting tools and/or templates	3.3								

[a]Likert scale ranging from 1 = "to no extent" to 5 = "to a very large extent" for facilitators and barriers, and 1 = "strongly disagree" to 5 = "strongly agree" for improvements.

most important based on the highest overall mean rating were: sufficiently clear guidelines on contact tracing (3.9), quick access to laboratory results (3.6), and sufficient expertise (3.6) (Table 2, Appendix S4, Section 4, Figure S1). Good communication with community stakeholders received the second lowest rating (3.0). Stratifying by country (i.e., Germany, Spain, Austria, and others), results were similar except that Austria ranked an adequate system to collect and/or exchange data as the most important facilitator, together with sufficiently clear guidelines (Table 2, Appendix S4, Section 4, Figure S2).

Results were also similar by level of organization (Appendix S4, Section 4, Figure S3). However, good collaboration with other stakeholders involved in contact tracing was the second highest scoring facilitator, and good communication with community stakeholders was rated below three among respondents at the regional level. Among respondents at the local level, sufficient time was rated third highest together with sufficient expertise (Appendix S4, Section 4, Figure S3). Other facilitators of contact tracing mentioned by respondents that were not listed in the survey included a high level of support from the public health institute, national and international guidelines, collaboration with the municipality, execution of contact tracing by a nursing team, the low number of cases, and previous experience.

Highest overall rated barriers included the inability to contact contacts (3.0) or cases (2.5), lack of staff (2.4), and lack of time (2.4) (Table 2, Appendix S4, Section 5, Figure S4). Results were similar in the case of Germany, Spain, Austria, and responses from other countries combined, and across organizational levels, except that delay in reporting of laboratory results received the second highest rating in Germany and overall at the local level (Appendix S4, Section 5, Figure S5). Other barriers to contact tracing mentioned by respondents included lack of willingness to disclose contacts, stigma, lack of cooperation by contacts, delay in the access to postexposure prophylaxis, strict quarantine rules, and that investigation forms used were not designed to collect information on contacts.

Respondents prioritized the following improvements to contact tracing activities: availability of staff (3.5), expertise on affected populations including their sexual health and behaviors (3.4), availability of an adequate system to collect and/or exchange data (3.3), more time allocated to contact tracing (3.3), better communication with community stakeholders (3.3), and availability of data reporting tools and/or templates (3.3) (Table 2, Appendix S4, Section 6, Figure S7). Results were similar in the case of Germany, Spain, Austria, and other countries combined, and across organizational levels, except that better collaboration with other stakeholders on contact tracing was amongst the most needed improvements in Spain and overall at the regional level, and training on how to communicate with affected populations in countries other than Germany, Spain or Austria (Appendix S4, Section 6). Other improvements to contact tracing mentioned by respondents included having access to an interpreter or translator, obtaining standardized forms from the ECDC, and training of the involved staff.

4 | DISCUSSION

Between May 2022 and August 2023, approximately 26 000 cases of mpox were notified in the European region in relation to the multi-country outbreak in 2022.[5] In our overview of source investigation and contact tracing activities reported by 139 respondents from 27 out of 30 EU/EEA countries, we found that all surveyed countries performed one or more such activities, which showcases the role of contact tracing in the international response to infectious disease outbreaks. Nonetheless, specific activities, as well as approaches to collecting contact tracing data, varied between countries and levels. Sufficiently clear guidelines, quick access to laboratory results, and sufficient expertise were rated as the most important facilitators of contact tracing, while inability to contact cases and contacts of cases, together with lack of staff, were the most important barriers. Having expertise on affected populations, availability of staff, an adequate system to collect and exchange data and data reporting tools and templates were considered by respondents to be the most important necessary improvements.

Most respondents reported having performed case investigation and backward contact tracing for mpox cases. However, follow-up of contacts and recording of contacts' disease status was performed by few respondents. Differences in available resources, legal frameworks, public health infrastructure, and operational complexities across countries are likely contributors to the observed variations in contact tracing activities. Two specific resources related to capacity that were mentioned by the respondents as barriers and as needed improvements were (a) time and (b) staff.

Both backward and forward tracking of contacts are important to identify individuals with infection, with exposure to infection, or at risk of future exposure, with the aim of preventing further transmission. However, the 2022 mpox outbreak was characterized by a high number of sexual contacts linked to cases, particularly during large events like festivals or in other settings involving sexual encounters.[30,31] Within this context, two important barriers to effective mpox contact tracing highlighted by respondents across countries and levels were the inability to contact cases and their contacts. These barriers might be attributed to the high number of contacts and associated anonymity, with cases struggling to recall their interactions.[32] Nonetheless, the presence of these barriers could also hint at more profound issues concerning disclosure, stemming from societal stigma or perceived stigma attached to mpox and sexually transmitted infections.[10,33,34] In alignment with these challenges, the respondents underscored the importance of enhancing expertise concerning populations particularly vulnerable to mpox, including factors related to risk of exposure, along with the necessity for improved communication with stakeholders. The lack of expertise in conducting epidemiological investigations among affected populations could impede dissemination of vital information such as sexual behavior and hinder establishment of trust,[35] both of which are integral to fostering cooperation and engagement in the contact tracing process.

To help overcome the barriers to contact tracing outlined above and improve understanding of affected populations, it is important to facilitate information exchange at the regional, national, and international levels. During the 2022 outbreak, for example, international webinars such as those organized by the ECDC, European AIDS Clinical Society (EACS),[36,37] or national webinars organized by the Robert Koch Institute in Germany were well-attended; the latter were sometimes attended by over 1000 attendees.[38] To reach a wider audience, particularly public health professionals who bear the brunt of contact tracing activities during infectious disease outbreaks, it is important to develop easily-accessible training modules and guidelines in multiple languages, adjusting them to different contexts where possible. Moreover, nonstigmatizing methods for community engagement can help support better communication with stakeholders, such as collaborative workshops, focus groups, multisector partnerships, and community-led initiatives. Strategies to combat different types of stigma include obtaining a sex-positive sexual health history, recognizing potentially mitigating factors associated with disease-associated stigma, and providing information about public health institutes' contact tracingpractices and protections for individual identities.[33] Finally, in addition to traditional contact tracing, previous studies on sexually transmitted infections such as HIV and syphilis have indicated that it could be useful to specifically target persons attending large events involving sexual encounters,[39] and that internet or mobile technology-based contact tracing could increase HIV case detection[40] or the number of index patients with at least one partner receiving syphilis treatment.[41]

Interestingly, while two-third of respondents used a standardized contact tracing form or template, approximately one-third did not. In line with this, improvements listed as most important included data reporting tools and templates. Case report and contact tracing forms have been made available by the WHO, ECDC, or respective national health institutes, and used by a significant proportion of respondents, but some organizations perhaps did not feel the need or were insufficiently aware of their existence, or might have faced challenges related to their clarity and adaptability. For optimal utility, contact tracing forms should be clear and user-friendly, requiring minimal additional training for completion, as also indicated by the respondents. Moreover, customization of these forms to suit for example various languages is a consideration to enhance their applicability.

Moreover, findings showed notable heterogeneity in data recording practices and the software systems employed for data collection. Respondents clearly listed the necessity for an adequate system to collect and exchange data as a key improvement. The differences in existing data collection systems likely stem from differences in notification and surveillance systems across countries. Herein lies a challenge, as a more harmonized approach could allow international data aggregation, which could, in turn, facilitate operational research and coordination activities. To this end, it is important to establish an accessible and user-friendly international data collection system with common data protection standards and practices within the EU/EEA. In practice, however, the realization of such a system might be challenging, underlining the relevance of feasible strategies to harmonize contact tracing data collection. This could include, for example, a minimal data set with uniform data formats or the use of open-access digital tools that enable data export in these formats.

This study was the first to provide an overview of mpox contact tracing activities in EU/EEA countries while also identifying areas for improvement. However, certain limitations to our approach need to be acknowledged. Firstly, the distribution of responses per EU/EEA country was uneven, with some countries providing a higher number of responses than others. This imbalance might be attributed to the recruitment method, which heavily relied on NFPs forwarding the survey invitation to relevant stakeholders. It might also be related to the structure of respective surveillance systems. Countries with more decentralized systems, like Germany, have a larger representation due to many respondents at the local level. As such, certain insights might have been missed, especially for larger countries with fewer responses, such as France, and for countries without any responses at certain levels. Therefore, while the presented percentages provide valuable insights, they should not be interpreted as prevalence estimates. In addition, these results might not be generalizable. However, stratified analyses by countries with the highest number of responses and responses from other countries combined, as well as by level of organization, did not show major differences in the relative importance of ranked facilitators, barriers, and improvements. Second, other potential limitations encompass participation bias and social desirability bias, even though the survey's anonymity was ensured and it was broadly promoted through available networks.

The absence of universally adopted standardized forms for contact tracing within the EU/EEA, coupled with heterogeneity in data collection and collection systems, continues to pose a challenge in estimating key parameters essential for accurate calculations of (secondary) mpox transmission rates. Based on the results from this study, we have formulated recommendations aimed at enhancing mpox contact tracing and the collection of contact tracing data at the international level. Findings from this study offer valuable guidance to countries preparedness and response, both immediate and sustained, to future global outbreaks of mpox and other infectious diseases.

4.1 | Recommendations

- Establish standardized definitions for contact tracing data at the beginning of an outbreak, possibly agreed on at the EU/EEA level.
- Provide a comprehensive data collection template for contact tracing activities, according to the country needs and languages.
- Streamline existing digital tools for contact tracing data in collaboration with all stakeholders, facilitating optimized data export and exchange in common formats.
- Facilitate the sharing of regional and local data to the national and EU/EEA level in a harmonized manner.

- Provide widely accessible training opportunities for enhancing contact tracing operations, including webinars and workshops, in multiple languages.
- Offer training programs on communication with affected groups, partner notification, understanding risk behavior, and inclusive techniques for engaging communities without perpetuating stigma.
- Increase workforce capacity in public and sexual health in countries during peace time and surge capacity procedures for contact tracing.
- Include periodic surveys at the EU/EEA level to collate contact tracing activities in EU/EEA countries and obtain information to improve activities and data collection in current and possible future infectious diseases outbreaks.

AUTHOR CONTRIBUTIONS

All authors contributed to the design of the study. Henrieke Prins and Liza Coyer wrote the study proposal including a first draft of the questionnaire with input from all other authors. Henrieke Prins, Liza Coyer, and Daniel Cauchi implemented the survey in REDCap, and Daniel Cauchi and Agoritsa Baka invited participants and sent out reminders. Henrieke Prins and Liza Coyer cleaned and analyzed the data with input from Daniel Cauchi, Agoritsa Baka, and Stefania De Angelis. Henrieke Prins and Liza Coyer wrote the manuscript under supervision of Agoritsa Baka and Stefania De Angelis. All authors critically revised the manuscript.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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