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**Article**

**Keywords:** Mpox, mpox vaccine, MVA-BN, vaccine safety, adverse event of special interest

**Posted Date:** November 20th, 2026

**DOI:** https://doi.org/10.21203/rs.3.rs-11692999/v1

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**Additional Declarations:** No competing interests reported.

# Real-world safety assessment of Mpox Vaccine in Catalonia: Retrospective Cohort Study of Adverse Events of Special Interest and Breakthrough Infections

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# ABSTRACT

Mpox vaccination with the Modified Vaccinia Ankara-Bavarian Nordic (MVA-BN) vaccine has been used to protect people at increased risk of infection, but real-world safety data from Europe remain limited. We conducted a retrospective cohort study of 8,039 adults in Catalonia, Spain, who received at least one MVA-BN dose between June 13, 2022 and December 31, 2024, using routinely collected primary care and linked hospital records. We looked for five prespecified adverse events of special interest (myocarditis, pericarditis, thrombocytopenia, anaphylaxis and generalized convulsive seizure) within 28 days after each dose, and described mpox infections diagnosed after vaccination. Participants were predominantly men (97.7%) and aged 26-45 years (68.0%). Adverse events were rare: fewer than five cases of pericarditis occurred within 28 days of vaccination (day 19 after the first dose), and no other event of special interest was identified in that window. Sixteen participants (0.20%; 95% confidence interval 0.11-0.32%) had a recorded mpox diagnosis after vaccination. These findings provide preliminary, region-specific reassurance about the short-term safety of MVA-BN. However, events were few, there was no unvaccinated comparison group, and the study cannot establish causality or vaccine effectiveness. Continued monitoring of vaccine safety is warranted.



*Keywords: Mpox; mpox vaccine; MVA-BN; vaccine safety; adverse event of special interest*

# BACKGROUND

Mpox is an acute infectious disease caused by monkeypox virus. The global outbreak of community transmission identified in May 2022 resulted in substantial transmission in regions where the virus had not previously circulated widely. Although the World Health Organization (WHO) no longer considers mpox a public health emergency of international concern, transmission continues and requires sustained preparedness and surveillance [1,2].

Spain was among the European countries most affected during the 2022–2023 outbreak. Catalonia accounted for a substantial proportion of national cases, and Barcelona experienced particularly high incidence [3–6]. In response, Spain implemented a targeted Modified Vaccinia Ankara–Bavarian Nordic (MVA-BN) vaccination program for populations at increased risk of exposure, including people with high-risk sexual exposures, selected healthcare and laboratory personnel, close contacts, and some immunocompromised populations [7]. The rapid implementation of targeted vaccination during the outbreak generated an important need for targeted prevention and vaccination, and post-authorization safety monitoring in the populations receiving the vaccine in routine clinical practice [8].

MVA-BN is live attenuated and non-replicating in human cells, allowing it to induce immunity without productive replication in humans [9,10]. Clinical trials and post-marketing surveillance have generally described a favorable safety profile for MVA-BN [9] as they have not identified a consistent excess of myocarditis or pericarditis attributable to the vaccine [9,11–15,19,20]. The rapid scale-up during the 2022 outbreak supported continued pharmacovigilance for prespecified adverse events of special interest (AESIs), particularly cardiac events [11–18], a concern stemming from older, replication-competent smallpox vaccines [11]. International surveillance has identified very few myocarditis or pericarditis events following MVA-BN vaccination, but much of the available real-world evidence has originated from North American surveillance systems [14,15,19,20]. Evidence from European population-based healthcare databases remains comparatively limited, particularly from settings where vaccination was implemented through targeted programmes and where primary care and hospital data can be linked. Real-world data from population-based healthcare databases can complement spontaneous reporting and other surveillance approaches by enabling systematic assessment of prespecified outcomes in defined vaccinated populations. In Catalonia, Spain the Sistema d'Informació per al Desenvolupament de la Investigació en Atenció Primària (SIDIAP) database provides access to routinely collected primary care data linked with other healthcare information and therefore offers an opportunity to characterize the short-term safety of MVA-BN in routine clinical practice.

Accordingly, this study aimed to describe the occurrence of five prespecified AESIs within 0–28 days after MVA-BN vaccination among adults in Catalonia. The five AESIs we included were myocarditis, pericarditis, thrombocytopenia, anaphylaxis, and generalized convulsive seizure (GCS) as indicated by the Safety Platform for Emergency Vaccines (SPEAC) to have a known or theoretical association with mpox vaccines [21]. As a secondary descriptive objective, we aimed to characterize post-vaccination mpox infections by vaccination status and period.

# METHODS

### *Study design and setting*

This retrospective cohort study used routinely collected primary care electronic health record (EHR) data from SIDIAP, to collect data beyond primary care settings from hospital discharge, , mortality, laboratory, vaccination, and other health-care information available within the database. SIDIAP includes approximately 5.8 million individuals across 328 primary healthcare centers and covers about 80% of the Catalan population [22].

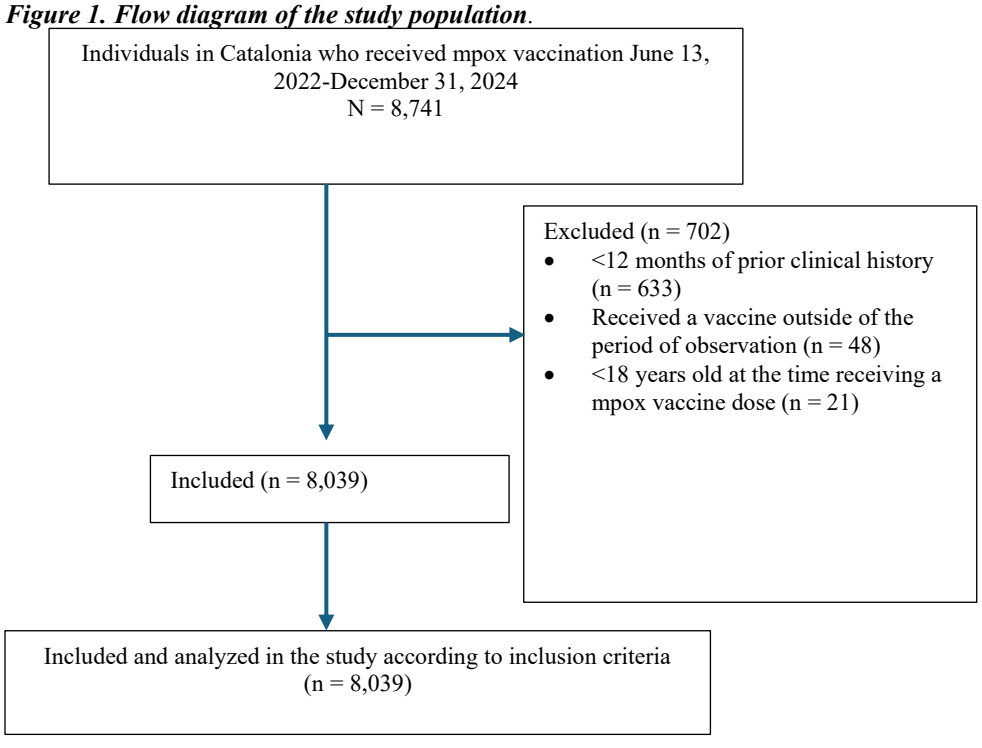
The study period was June 13, 2022, through December 31, 2024, corresponding to the latest SIDIAP data available for this analysis.

### *Study population*

We included adults aged ≥18 years residing in Catalonia who received at least one dose of MVA-BN (antigen code A00045) between June 13, 2022, and December 31, 2024. The index date was the date of the first recorded MVA-BN dose. Eligible individuals were required to have at least 12 months of continuous clinical history before the index date to support baseline characterization. Vaccination records were required to contain a valid vaccine date and vaccine identifier; records with duplicate or internally inconsistent dose information were excluded. For individuals receiving a second recorded dose, the date of dose 2 and the interval between doses were retained. Follow-up for safety was assessed separately after each recorded dose.

Of 8,741 individuals with a recorded mpox vaccination in the source population, 8,039 met the analytic eligibility criteria and therefore compromised the final analytic cohort. Figure 1 summarizes the cohort selection process.

***Figure 1. Flow diagram of the study population***.



### *Exposure and outcomes*

The primary exposure was receipt of at least one dose of MVA-BN. Vaccination exposure was characterized according to dose number (dose 1 or dose 2), recorded vaccination dates, and the interval between doses among participants with two recorded doses.

Primary safety outcomes were the five AESIs assessed within 0–28 days after each vaccine dose: myocarditis, pericarditis, thrombocytopenia, anaphylaxis, and GCS. AESIs were identified using standardized SPEAC case definitions and prespecified International Classification of Diseases, Tenth Revision, Clinical Modification (ICD-10-CM) codes (Supplementary Table S1) [21].

The secondary outcome was post-vaccination mpox infection, identified using the ICD-10-CM B04 diagnostic code . Breakthrough infections were assessed after initial vaccination, stratified by time since vaccination (post-dose 1 with no second dose planned; between doses; post-dose 2) and the number of total doses received, within the study time-period from June 13, 2022 to December 31, 2024.

### *Covariates*

Baseline sociodemographic variables were age (18–25, 26–35, 36–45, >45 years), recorded sex, country of birth (Spain/other), and area-level socioeconomic deprivation, measured with the MEDEA (Mortalidad en áreas pequeñas españolas y Desigualdades Socioeconómicas y Ambientales; Mortality in Small Areas in Spain and Socioeconomic and Environmental Inequalities) deprivation index [23]. MEDEA is a census-based composite indicator developed to characterise socioeconomic deprivation in small urban areas (census tracts). Index values were categorised into quintiles, from least (Q1) to most (Q5) deprived.

Comorbidities identified from ICD-10-CM codes in all available clinical history before the index date included diabetes, hypertension, dyslipidemia, chronic kidney disease, serious heart disease, immunocompromising conditions, HIV infection, and transplantation (Supplementary Table S2).

Previous COVID-19 vaccination was summarized as 0, 1, 2, or ≥3 recorded doses.

Lifestyle variables included smoking status and alcohol risk category as recorded by primary care professionals, and nutritional status based on pre-specified body mass index (BMI) categories [24] recorded in the clinical record.

Sexually transmitted infections (STI) recorded during the 12 months before the index date included gonorrhea, chlamydia, and syphilis (Supplementary Table S3).

### *Statistical analysis*

Analyses were descriptive. Categorical variables were summarized as counts and percentages; continuous variables were summarized using means and standard deviations (SD) or medians and interquartile ranges (IQR), as appropriate. For AESIs, we counted individuals with at least one event within the prespecified 0–28-day risk window after each dose and reported the corresponding crude frequency. Counts below five were suppressed in accordance with SIDIAP data-governance requirements.

Due to the nature of the cohort only including individuals who were vaccinated and sparse event counts, no comparative risk estimates, multivariable models, or observed-versus-expected analyses were undertaken.

For breakthrough mpox, we report the number and crude proportion of vaccinated individuals with at least one recorded infection during the study period, overall and stratified by

vaccination dose status. Ninety-five percent confidence intervals (95% CI) for these proportions were calculated using the exact Poisson methods. We did not report incidence rates based on person-time because individual follow-up was heterogeneous and the available analysis was not designed around a fixed risk horizon.

The analysis was therefore prespecified as descriptive and did not estimate vaccine effectiveness. All analyses were conducted using R version 4.4.0. Generative artificial intelligence tools were used only for language editing and manuscript organization. All scientific decisions, analyses, interpretations, and final text were conducted, reviewed, and approved by the authors.

# RESULTS

### *Baseline characteristics*

A total of 8,039 vaccinated adults were included (Table 1). The cohort was predominantly male (7,856/8,039, 97.7%), and 68.0% were aged 26–45 years. Most participants were born in Spain (62.7%). The socioeconomic profile was skewed toward less deprived areas: 27.4% of participants were in the least deprived MEDEA quintile (Q1), compared with 12.1% in the most deprived quintile (Q5). Lifestyle characteristics also showed distinct patterns in the recorded data: the medium-risk alcohol category was the most frequently documented (41.0%), non-smoking was the most common recorded smoking status (40.1%), and normal weight (18.5 to 25.5 $kg/m^2$) [24] accounted for 28.1% of the cohort's nutritional status.

171 ***Table 1. Baseline characteristics of adults vaccinated with MVA-BN in Catalonia.***

| Variables | Distribution, n (%) |
|---|---|
| **Overall** | 8,039 |
| ***Sex*** | |
| Men | 7,856 (97.72) |
| Women | 183 (2.28) |
| ***Age, years*** | |
| 18-25 | 393 (4.89) |
| 26-35 | 2,592 (32.24) |
| 36-45 | 2,879 (35.81) |
| >45 | 2,175 (27.06) |
| ***Country of origin*** | |
| Spain | 5,040 (62.69) |
| Outside of Spain | 1,907 (23.72) |
| Missed | 1,092 (13.58) |
| ***Socioeconomic Index MEDEA**** | |
| Q1 | 2,204 (27.42) |
| Q2 | 1,533 (19.07) |
| Q3 | 1,047 (13.02) |
| Q4 | 891 (11.08) |
| Q5 | 974 (12.12) |
| Missed | 1,390 (17.29) |
| ***Alcohol risk*** | |
| Low risk[a] | 1,603 (19.94) |
| Medium risk[b] | 3,299 (41.04) |
| High risk[c] | 98 (1.22) |
| Missed | 3,039 (37.8) |
| ***Covid-19 vaccine doses*** | |
| 0 doses | 238 (2.96) |
| 1 dose | 300 (3.73) |
| 2 doses | 2,106 (26.20) |
| ≥3 doses | 5,395 (67.11) |
| ***Comorbidities*** | |
| Type 1 and 2 diabetes | 91 (1.13) |
| Hypertension | 506 (6.29) |
| Dyslipidaemia | 445 (5.54) |
| Immunocompromised (any) | 336 (4.18) |
| Serious heart conditions | 72 (0.90) |
| Kidney diseases | 70 (0.87) |
| Human Immunodeficiency Virus | 235 (2.92) |
| Transplants | 7 (0.09) |
| ***Sexually Transmitted Infections*** | |
| Gonorrhea | 138 (1.72) |
| Chlamydia | 93 (1.16) |
| Syphilis | 78 (0.97) |

Abbreviations n: number

* MEDEA:1, least socioeconomic deprived population – 5, most socioeconomic deprived population

a: low risk defined as 0-2 standard drink units for women and 0-4 for men.

b: medium risk defined as 2-4 standard drink units for women and 4-6 for men.

c: high-risk defined as 4 or more standard drink units for women and 6 or more for men.

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173 Lifestyle variables had substantial missingness (nutritional status 48.2%, alcohol risk
174 37.8%, and smoking status 37.1%), therefore these distributions should be interpreted as
175 characteristics of the recorded data rather than population-representative estimates.

### *Vaccination exposure patterns*

Among the 8,039 participants, 3,301 (41.1%) had one recorded dose and 4,738 (58.9%) had two recorded doses. Among those with two doses, the mean interval between doses was 130.4 days (SD 128.8; range 23–815 days), reflecting substantial variation in real-world dosing intervals during the vaccination programme (Table 2).

***Table 2. MVA-BN vaccination patterns and inter-dose interval.***

| Category | N (%) | Mean interval (days) | SD (days) | Range (days) |
|---|---|---|---|---|
| Total Vaccinated | 8,039 (100) | - | - | - |
| One recorded dose | 3,301 (41.1) | - | - | - |
| Two recorded doses | 4,738 (58.9) | 130.4 | 128.8 | 23 - 815 |

### *Adverse events of special interest*

Within the prespecified 0–28-day risk windows after vaccination, fewer than five pericarditis cases were identified and occurred between doses with a mean of 19 days after initial vaccination. No myocarditis, thrombocytopenia, anaphylaxis, or generalized convulsive seizure was identified within the corresponding risk windows (Table 3).

***Table 3. Prespecified AESI-coded events identified within 28 days after MVA-BN vaccination.***

| AESI | Number of individuals, n |
|---|---|
| Myocarditis | 0 |
| Pericarditis | <5 |
| Thrombocytopenia | 0 |
| Anaphylaxis | 0 |
| Generalized convulsive seizure | 0 |

Cell counts <5 were suppressed in accordance with SIDIAP data-governance requirements.

### *Post-vaccination mpox infection*

During available follow-up, 16 of 8,039 participants (0.20%; 95% CI 0.11–0.32%) had a recorded post-vaccination mpox infection. Six infections occurred among the 3,301 one-dose recipients (0.18%; 95% CI 0.07–0.40%). Among the 4,738 participants with two recorded doses, five infections occurred between doses 1 and 2 (0.11%; 95% CI 0.03–0.25%) and five after dose 2 (0.11%; 95% CI 0.03–0.25%) (Table 4).

***Table 4. Post-vaccination mpox infections by vaccination status and period.***

| Vaccination status | Period | Cases, n (%) | 95% CI for proportion |
|---|---|---|---|
| Overall | Post-vaccination mpox infection | 16/8,039 (0.20%) | 0.11–0.32% |
| One recorded dose | After dose 1 | 6/3,301 (0.18%) | 0.07–0.40% |
| Two recorded doses | Between doses 1 and 2 | 5/4,738 (0.11%) | 0.03–0.25% |
| Two recorded doses | After dose 2 | 5/4,738 (0.11%) | 0.03–0.25% |

# DISCUSSION

In this retrospective cohort of 8,039 adults vaccinated with MVA-BN in Catalonia, few prespecified AESI-coded events were identified within the biologically plausible 0–28-day risk windows, with fewer than five pericarditis cases and no other prespecified AESI. These findings are consistent with international pharmacovigilance data on the short-term safety of MVA-BN [19-20].

The cohort characteristics reflect the population targeted by the Catalan vaccination programme. The marked predominance of men is consistent with vaccination targeting, although sexual orientation was not available in SIDIAP and should not be inferred from sex alone. Similarly, the prevalence of recorded HIV infection (2.9%) was nearly ten times the estimated prevalence in the general Spanish population (approximately 0.31%) [25], consistent with eligibility criteria prioritizing populations at elevated risk for both HIV and mpox. This is relevant to AESI occurrence, as individuals living with HIV may have distinct cardiovascular and immunological risk profiles, including higher background rates of certain inflammatory conditions, that could influence AESI occurrence independently of vaccination [26]. MVA-BN is nonetheless considered safe for this population [27]. Finally, the MEDEA distribution was weighted toward less deprived areas. While the study design does not permit inference about inequalities in vaccine access or uptake, this distribution may limit generalizability and, if associated with lower baseline morbidity, could contribute to a healthy vaccinee effect when comparing observed AESI rates with general-population background rates.

No myocarditis occurred within 28 days after either dose. This is consistent with U.S. Vaccine Safety Datalink (VSD) analyses of >90,000 doses, which found no statistically significantly elevated standardized incidence ratios (SIRs) for the composite outcome of myocarditis or pericarditis; among men, the SIR was 0.81 (95% CI: 0.02–4.54) after dose 1 and 1.09 (95% CI 0.03-6.06) after dose 2 [20]. Fewer than five pericarditis cases were recorded within the risk window in our cohort. In an adjudicated review of 3,235 JYNNEOS (MVA-BN) doses, none of the 10 confirmed cardiac events were assessed as causally related to vaccination, and all occurred in individuals with preexisting risk factors [15]. Given the small numbers of pericarditis events and the absence of a suitable comparator group, the study cannot quantify a relative risk or determine whether the observed pericarditis diagnoses exceeded the expected background frequency.

No thrombocytopenia was identified within the 0–28-day risk window. Four post-vaccination diagnoses occurred at a mean of 299.2 days (SD: 215.6; range: 87–600) after the second dose, well outside the pre-specified window, and are more plausibly attributable to background incidence than a vaccine-triggered mechanism. Thrombocytopenia is not uncommon in the general population: European background rates of 38.99 cases per 100,000 person-years (95% CI: 7.23–70.76) in primary-care-only settings and 92.09 (95% CI: 42.47–141.71) with linked hospital data [28]. Therefore, these findings provide no evidence of a short-term temporal association.

Similarly, no anaphylaxis was identified within the risk window. U.S. surveillance across 1.2 million doses reported 3.04 anaphylaxis cases per million doses, comparable to other vaccines and within accepted safety thresholds [29]. Given this rarity, a cohort of our size would be unlikely to capture any anaphylaxis cases, so the absence is consistent with existing evidence but cannot independently confirm a low risk. In addition, the standard 15–30-minute post-administration observation period is designed to capture rare true anaphylactic reactions, so reactions treated on site may not have been recorded in primary care or hospital data, or anywhere else that could or could not have been linked to the SIDIAP database.

The absence of generalized convulsive seizures in the cohort is also reassuring. This finding is consistent with a global surveillance study excluding seizures as an MVA-BN safety signal [30]. Another study had been no reported Guillain-Barré syndrome cases, a related neurological AESI, across all dose windows (SIR: 0) [20]. Our event rarity and the reliance on routinely recorded diagnoses mean that very rare events cannot be excluded.

Sixteen post-vaccination mpox infections were recorded, representing 0.20% of the vaccinated cohort during available follow-up. For context, Catalan surveillance data study from the same outbreak period (n=2,122) found that 23.7% of cases among people with HIV and 14.5% without HIV had already received at least one MVA-BN vaccine dose at diagnosis [17]. In that study, vaccination introduction was accompanied by a sharp and statistically significant decline in mpox incidence among both groups ($p < 0.0001$) [17]. Although this temporal association may also reflect concurrent changes in sexual behaviour, it is compatible with a population-level contribution of vaccination.

Our cohort's mpox infections provide clinical context but should not be interpreted as a vaccine-effectiveness estimate. Crude proportions were low and numerically similar across the inter-dose and post-dose-2 periods, but these periods differed in calendar time and follow-up, and no unvaccinated comparator was available. These findings therefore are descriptive and cannot establish an incremental protective effect of the second dose. They are nonetheless compatible with other existing evidence that MVA-BN provides substantial, though incomplete, protection against mpox. One U.S. case-control study estimated more modest adjusted vaccine effectiveness of 35.8% (95% CI 22.1-47.1) after one dose and 66% (95% CI 47.4-78.1) after two doses [31]. Whereas high-effectiveness estimates from a Spanish test-negative designed study estimated 76-89% vaccine effectiveness following the first dose and higher following two-dose completion [32].

Our secondary outcome findings help contextualize the safety analysis by describing mpox infections occurring during the same period of MVA-BN vaccine exposure and follow-up, without changing the study's primary focus on safety. These findings also reinforce the public health rationale for the Catalan mpox vaccination program and support continued efforts to maximize two-dose completion rates among at-risk populations.

## STRENGTHS AND LIMITATIONS

Strengths include the population-based real-world setting, linkage of primary care and hospital data, systematic capture of vaccination dates, use of prespecified SPEAC case definitions and ICD-10-CM algorithms, and coverage of the full period of MVA-BN use represented in the available SIDIAP data. The study also addresses a geographic evidence gap by contributing safety data from Catalonia to the European pharmacovigilance evidence base.

This study also has several limitations. First, the small number of observed AESI events limited precision, and given the cohort size very rare AESIs were unlikely to be detected, and their absence cannot exclude a low level of risk. Second, the vaccinated-only cohort design, without an unvaccinated comparator, precludes comparative risk estimation. Third, follow-up for post-vaccination mpox infections was heterogeneous. Fourth, outcomes and comorbidities were identified from routinely recorded diagnosis codes without individual chart validation, which may have introduced misclassification bias and under-ascertainment. Fifth, the cohort was weighted toward less deprived areas, which may have introduced a healthy vaccinee effect and limits generalizability to more socioeconomically and immunologically diverse populations. Given its descriptive design, the study cannot establish causality or vaccine effectiveness.

## PUBLIC HEALTH IMPLICATIONS

From a public health perspective, these findings provide preliminary regional reassurance regarding the absence of frequent prespecified AESI-coded events within 28 days after MVA-BN vaccination, while demonstrating why rare-event safety assessment benefits from pooling

across jurisdictions. For vaccine-eligible communities, the appropriate message is not that this study proves vaccine safety, but that few prespecified events were identified through systematic assessment of routinely collected health data and that continued surveillance remains necessary. The findings could support maintaining vaccination programmes in at-risk populations.

## CONCLUSIONS

In conclusion, among 8,039 adults vaccinated with MVA-BN in Catalonia, fewer than five pericarditis cases were identified within 28 days after vaccination and no other prespecified AESI was recorded in the risk windows. Sixteen post-vaccination mpox infections were identified during available follow-up. These findings provide preliminary regional reassurance regarding short-term MVA-BN safety and contribute real-world evidence to the European pharmacovigilance evidence base. For practitioners and program managers in Catalonia, these data provide preliminary reassurance regarding the short-term safety profile of MVA-BN in a real-world, high-risk population, while reinforcing the importance of transparent communication of both findings and their limitations to sustain vaccine confidence among at-risk communities

Future research should prioritize continued surveillance and pooled studies using validated outcomes and appropriate comparator designs for robust AESI incidence estimation and subgroup analyses, including stratification by HIV status, dose schedule, and socioeconomic deprivation, and improved vaccine effectiveness characterization that individual regional studies cannot support on their own.

Observational studies incorporating formally matched unvaccinated comparator groups and active surveillance designs are needed to move beyond descriptive findings and generate the causal inference necessary to definitively characterize the benefit-risk profile of MVA-BN across diverse European populations.

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# LIST OF ABBREVIATIONS

MVA-BN, modified vaccinia Ankara–Bavarian Nordic
AESI, adverse event of special interest
SIDIAP, Sistema d'Informació per al Desenvolupament de la Investigació en Atenció Primària
GCS, generalized convulsive seizure
SPEAC, Safety Platform for Emergency Vaccines
BMI, body mass index
CI, confidence interval
EHR, electronic health record
ICD-10-CM, International Classification of Diseases, Tenth Revision, Clinical Modification
IQR, interquartile range
SD; standard deviation
STI, sexually transmitted infection
WHO, World Health Organization.

# DECLARATIONS

***Ethics approval and consent to participate***

The study was conducted in accordance with the Declaration of Helsinki and was approved by the Ethics Committee of IDIAP Jordi Gol (protocol code 21/199-PCV). The use of routinely collected health data for this research was covered by the approved protocol, and individual informed consent was not required because of the retrospective nature of the study and use of routinely collected data.

***Consent for publication***

Not applicable. The manuscript contains no individual-level identifiable information, images, or videos.

***Availability of data and materials***

The SIDIAP data used for this study are not publicly available because of legal, ethical, and data-governance restrictions. Access to SIDIAP data may be requested by eligible researchers through the SIDIAP data-access process and is subject to approval and applicable conditions.

***Competing interests***

The authors declare that they have no competing interests.

***Funding***

This research received no external funding.

***Authors' contributions***

FV, ASR, IC, MS and VRP conceptualized the study and developed the methodology. FV, ASR, and VRP contributed to the formal analysis. FV, ASR, IC, MS, MF and VRP contributed to investigation and interpretation. MF and VRP contributed to data curation. FV and ASR drafted the manuscript. All authors contributed to critical review and editing and approved the final manuscript.

***Acknowledgements***

The authors thank IDIAPJGol and the SIDIAP team for their support and technical contributions to this study. IC thanks to Prof. E. Lucenteforte, who funded her postdoctoral period at IDIAPJGol.

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## SUPPLEMENTARY MATERIAL

Additional file 1. Supplementary Table S1. AESI ICD-10-CM diagnostic codes.
Additional file 2. Supplementary Table S2. Comorbidity ICD-10-CM diagnostic codes.
Additional file 3. Supplementary Table S3. Sexually transmitted infection ICD-10-CM diagnostic codes.

## Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- 3.Additionalfile1SupplementaryTableS1.docx
- 4.Additionalfile2SupplementaryTableS2.docx
- 5.Additionalfile3SupplementaryTableS3.docx