# The Vulture Emergency

## Non-Steroidal Anti-Inflammatory Drug (NSAID) risks to Health and Biodiversity

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World Organisation for Animal Health

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The introduction of the NSAID diclofenac for veterinary use in South Asia in the 1990s led to the collapse of most vulture populations in this region such as this Indian Vulture (*Gyps indicus*) and a 99.9% decline of the White-rumped Vulture (*Gyps bengalensis*). Loss of vulture ecosystem services also led to serious consequences for human health.

# Content

# Introduction: the veterinary drug challenge for wild birds

Non-Steroidal Anti-Inflammatory Drugs (NSAIDs) are essential veterinary drugs and are commonly used worldwide to alleviate pain, reduce inflammation, and lower fever in animals, including livestock. While the NSAIDs, meloxicam and tolfenamic acid have been found to be safe, several other NSAIDs are known to be highly toxic to various scavenging raptor species (both vultures and large eagles) and may pose risks to other wildlife[1] (see Table 1). The toxicity of other NSAIDs in widespread use is unknown. NSAIDs, and particularly diclofenac toxicity, was identified as the main cause of the catastrophic collapse of vulture populations across South Asia which started in the 1990s.

The majority of the 15 African-Eurasian migratory vulture species are globally threatened and are listed in the Appendix I and/or II of the Convention on Migratory Species (CMS) and in the IUCN (2025) Red List of Threatened Species. The CMS has recognised that non-infectious diseases, such as toxicity from poisons - including exposure to veterinary drugs unrelated to treatment - are substantive causes of migratory bird mortality and pose serious threats to their conservation status.

Urgent international measures are required to mitigate exposure to poisoning. The importance of taking action relating to this urgent issue is also recognised by CMS through Resolution 11.15 (Rev. COP15). The CMS Multi-species Action Plan to Conserve African-Eurasian Vultures (Vulture MsAP) also aims to restore these populations to a favorable conservation status by 2029 across each species' Range State[2].

| NSAID | TOXICITY | REFERENCE | |
|---|---|---|---|
| DICLOFENAC | Toxic | Oaks *et al.* (2004)<br>Shultz *et al.* (2004)<br>Swan *et al.* (2006) | Green *et al.* (2007)<br>Sharma *et al.* (2014) |
| KETOPROFEN | | Naidoo *et al.* (2010) | |
| ACECLOFENAC | | Galligan *et al.* (2016)<br>Chandramohan *et al.* (2022) | |
| NIMESULIDE | | Cuthbert *et al.* (2016)<br>Nambirajan *et al.* (2021) | Galligan *et al.* (2022)<br>Mathesh *et al.* (2023) |
| FLUNIXIN | | Zorrilla *et al.* (2015)<br>Fourie *et al.* (2015) | Herrero-Villar *et al.* (2020)<br>Chakraborty *et al.* (2025) |
| CARPROFEN | Toxic at high doses | Naidoo *et al.* (2018) | |
| MELOXICAM | Safe | Cuthbert *et al.* (2016)<br>Swan *et al.* (2006) | Swarup *et al.* (2007) |
| TOLFENAMIC ACID | | Chandramohan *et al.* (2022) | |

**Table 1: Toxicity and safety to Gyps vultures of different non-steroidal anti-inflammatory drugs (NSAIDs).** (Adapted from Cook *et al.*, 2024)

1. Palocz, O.& Gál, J.& Csikó, G. (2016). Differences in NSAID Toxicity in Four Avian Species. Journal of Veterinary Science and Medical Diagnosis. 5. 2. https://doi.org/10.4172/2325-9590.1000193

2. In accordance with the Convention on Migratory Species (CMS) (Art. I(1)(h)), a "Range State" is any State that exercises jurisdiction over any part of the natural range of a migratory species, including where the species breeds, forages, roosts, migrates, or otherwise occurs within its territory or airspace.

# Mechanism of toxicity: a clinical overview for veterinarians

1. **Exposure Pathway:** The primary exposure pathway for vultures is the consumption of livestock carcasses that have been treated with specific NSAIDs shortly before death, where access to livestock carcasses is not prevented. In some cases, the active ingredient of the drug is toxic to vultures. In other cases, such as the NSAID aceclofenac, it is its principal metabolite in cattle (diclofenac) that is toxic. Normally, the toxic active ingredients of drugs are metabolised by cattle to non-toxic metabolites; however, if the cow dies within a few days of treatment, and depending on the particular NSAID residue kinetics, there may be insufficient time for this breakdown of metabolites (the metabolic window), and the tissues of treated cattle remain toxic to some species of scavenging raptors. In the case of diclofenac, it is known that tissues of treated animals remain toxic to old world vultures long after the animal's death.

2. **Pathological Effect:** Ingestion of tissues contaminated with a sufficient level of a toxic NSAID results in the susceptible bird's death within a few days, due to renal damage which leads to acute **visceral gout and kidney failure**.

3. **Physiopathology:** Visceral gout results from a severe form of kidney damage that causes the accumulation of uric acid crystals in the bird's blood and internal organs.

4. **Timeframe:** A susceptible bird may take up to **three days to die** after feeding on an NSAID-contaminated carcass. Hence, susceptible birds are probably asymptomatic for hours to days following exposure and may travel far from the site of NSAID ingestion during this period. This complicates the determination of the exact source of exposure.

It is important to note that treated cattle can metabolise and excrete NSAIDs usually within a few days (NSAID dependent) of treatment. If the treated animal dies after the compound is metabolised, it no longer poses a threat to vultures. However, if it dies within this critical period, tissues remain highly toxic if consumed by scavengers. Mathematical models[3] demonstrate that fewer than one in 200 carcasses carrying a lethal dose of a toxic NSAID can cause rapid vulture population declines, given their sensitivity to the toxins and the social nature of vulture feeding (e.g. one contaminated carcass exposing numerous birds).


Individual contaminated carcasses have the potential to expose many individuals of multiple species.

3. Green, R. E., Newton, I., Shultz, S., Cunningham, A. A., Gilbert, G., Pain, D. J., & Prakash, V. (2004). Diclofenac poisoning as a cause of vulture population declines across the Indian subcontinent. Journal of Applied Ecology, 41, 793–800. https://doi.org/10.1111/j.0021-8901.2004.00954.x

# Toxic NSAIDs and their ecosystemic and health consequences

The introduction of the NSAID **diclofenac** for veterinary use in South Asia in the 1990s led to the collapse of most vulture populations in this region in less than 15 years, including a 99.9% decline of the White-rumped Vulture (*Gyps bengalensis*). Widespread use of diclofenac in livestock caused millions of vulture deaths before regulatory changes took effect.

Importantly, the rapid decline of vulture populations led to the loss of their crucial ecosystem service, carcass removal. This had cascading significant consequences for human health in India and retrospective analyses attributed this in partto a rise in human rabies cases linked to an increase in feral dog populations, previously kept in check by vulture carcass cleanup[4].

Subsequent evidence demonstrated the NSAID **flunixin** also posed a significant toxicity risk to vultures, with the first death of a wild Eurasian Griffon Vulture (*Gyps fulvus*) in Spain, with additional flunixin-related cases in Spain and Israel indicating wider impacts from this toxic NSAID. Despite diclofenac bans in place in South Asia, the first confirmed flunixin-related death of a Himalayan Griffon (*Gyps himalayensis)* in India was reported in 2025.

In 2020, the first death of a wild vulture outside Asia due to diclofenac poisoning was confirmed in Spain, a fledgling Cinereous Vulture (*Aegypius monachus*). Diclofenac has also been reported to be toxic in other scavenging raptors, with a case in wild Steppe Eagles (*Aquila nipalensis*) in India.

These events highlight the ongoing, transboundary threat of several NSAIDs to vultures and potentially other scavenging raptors across their range and the need for *regulation and responsible use of NSAIDs to mitigate risks*.


Eagles, such as this Steppe Eagle (*Aquila nipalensis*), are now known to be sensitive to the toxic effects of NSAIDs.

4. Frank, E. & Sudarshan, A. (2024). The Social Costs of Keystone Species Collapse: Evidence from the Decline of Vultures in India. American Economic Review, 114 (10): 3007–40, https://www.aeaweb.org/articles/pdf/doi/10.1257/aer.20230016

# Regulatory status

Bans on the manufacture, sale, and use of veterinary diclofenac have been published in the respective government registers of several Asian countries, thereby making the ban legally in force and fully enforceable. The countries include Bangladesh, India, Iran, Nepal, Pakistan, Cambodia, and Oman. Bangladesh was the first Range State to ban the veterinary use of ketoprofen in 2021. India subsequently introduced bans on ketoprofen and aceclofenac for veterinary use in 2023, followed by nimesulide in 2024.

These national bans represent an effective risk-mitigation measure applied when specific veterinary medicines pose unacceptable risks to wildlife or the environment. More broadly, in some regions and countries, veterinary medicines should undergo comprehensive pre-approval evaluation, including an environmental risk assessment that considers potential impacts on wildlife when relevant. For example, when assessing NSAIDs for livestock, regulators should evaluate potential risks to scavenging birds by examining the drug's metabolism, expected use patterns, and carcass-disposal practices. Where risks are identified, mitigation measures—ranging from product-label instructions to full prohibitions on manufacture or use—should be applied. It remains the responsibility of users to follow all label instructions and associated mitigation measures.

Diclofenac remains authorised for use in several EU countries across much of Africa and West Asia, and many countries of the western hemisphere.


Regulatory bans on toxic NSAIDs help ensure fewer risks to species like this European Griffon Vulture (*Gyps fulvus*) as individual contaminated carcasses are typically fed upon by large numbers of scavengers. Modelling indicates that fewer than 1 in 200 carcasses containing a lethal dose of NSAID can cause population decline.


Vultures such as these Himalayan Griffon Vultures (*Gyps himalayensis*) perform the important ecosystem service of rapidly consuming animal carcasses. Effective prevention of risks from toxic NSAIDs relies on regulatory frameworks and shared systems of involving veterinary practitioners, competent authorities, livestock owners and carcass management structures.

# Call for action

National Veterinary Services, other national competent authorities and individual veterinary clinicians have a crucial role in addressing the ongoing use of toxic NSAIDs and preventing vulture mortality, aligning with the CMS Resolution 11.15 (Rev. COP15) and their Guidelines to Prevent the Risk of Poisoning to Migratory Birds.

This includes raising awareness among individual veterinary clinicians about the risks posed by toxic NSAIDS, as well as strengthening regulatory enforcement to prevent misuse. Examples include preventing diclofenac meant for human medicine into illegal veterinary use as well as combating unlawful manufacture and distribution of large, veterinary-sized vials[5].

Effective prevention relies on a shared system of responsibility, involving veterinary practitioners, competent authorities, livestock owners and carcass management structures. The different actors are encouraged to work together and the veterinary services in particular, are encouraged to work with their environment sector and public health counterparts on ways to mitigate this issue within a One Health approach.

5. Mallord, JW, Prakash, VM, Bhusal, KP, Sarowar Alam, ABM, Chaudhry, MJI, Chakraborty, SS, Barathidasan, S, Bohra, DL, Dubey, A, Prakash, N, Ranade, S, Shringapure R, Chaudhary, IP, uJoshi, AP, Kabir, T, Ahmed, S, Azmiri, KZ, Murn, C, Bowden, CGR & Green, RE. (2025). The continued threat of toxic NSAIDs to Critically Endangered Gyps vultures in South Asia. Bird Conservation International. 35: e38. https://doi.org/10.1017/S0959270925100270

## Guidance for national veterinary services, national wildlife health authorities and national veterinary medicine agencies

National Veterinary Services and other national competent authorities responsible for veterinary product registration and distribution, are urged to implement regulatory and support measures in line with CMS Resolution and other instruments.

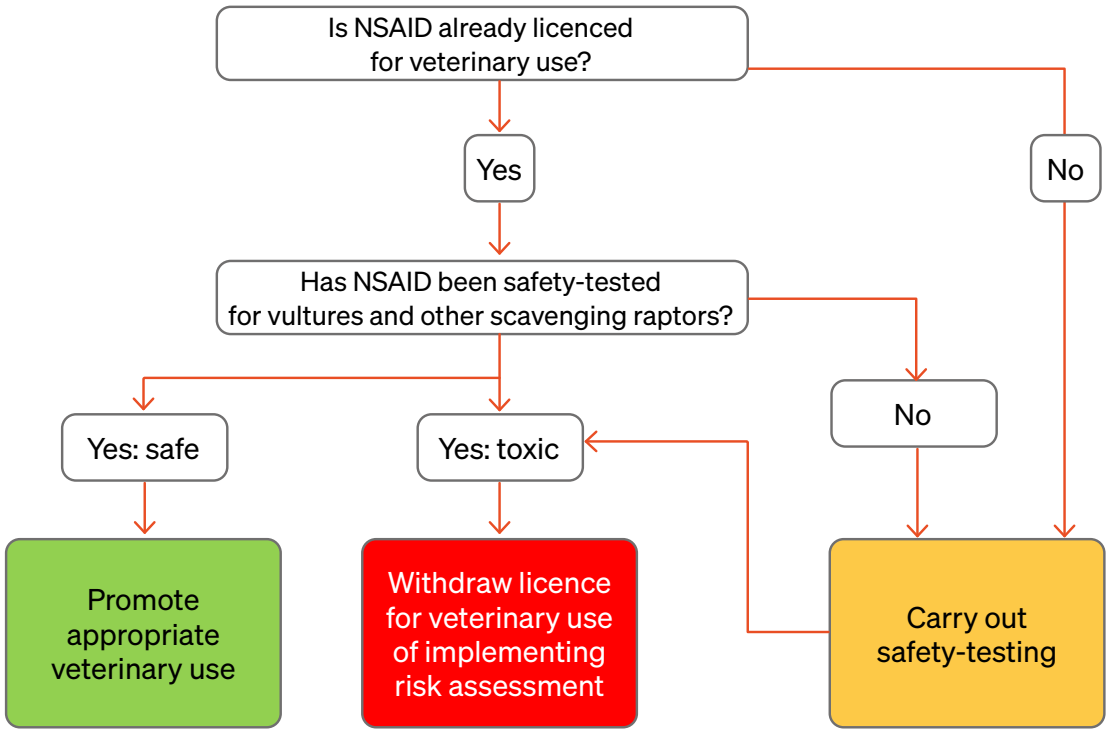
### A. PRUDENT PRESCRIPTION AND DRUG SELECTION

- **Licensing withdrawal and risk assessment:**

  - **Withdraw licensing** of vulture-toxic NSAIDs (including diclofenac) for veterinary use **until risk assessment is conducted and effective and practical risk mitigation actions can be implemented**.

  - Implement a **comprehensive risk assessment** with particular reference to known regional threats to vultures and other scavenging raptors, see figure 1 below.

Figure 1: NSAID use risk assessment diagram




- **Mandatory safety testing (R&D Requirements):**

  - Ensure safety testing of new veterinary NSAIDs for scavenging raptors is a mandatory part of the research and development (R&D) protocol, aligned with standards for safety testing of veterinary drugs, avoiding unnecessary duplication of safety testing (given conservation status of sensitive species), and using closely related species when necessary.

  - As with other pharmaceuticals, this testing should be the responsibility of the pharmaceutical industry in agreement with the appropriate national competent authority and regulations to avoid unnecessary duplication of safety testing (given conservation status of sensitive species), and licensing should be conditional on the results of these safety tests.

- **Capacity building and promotion:**

  - Contribute to the identification, awareness and **promotion of safe alternative drugs**.

  - Strengthen national and local capacity for implementing this guidance, including developing training courses for other competent authorities (see below), veterinary personnel and other relevant personnel, and disseminating examples of best practices.

- **Education of other relevant competent government authorities.**

  This may include but is not limited to drug control agencies, public health agencies and agencies providing veterinary support to farmers.

  - Inform drug control agencies about the risks toxic NSAIDs pose to vultures and other scavenging raptors, including NSAIDs approved for veterinary use that are known to be toxic, those demonstrated to be safe as well as NSAIDs whose toxicity has not been tested.

  - Make all relevant competent authorities (such as veterinary services, wildlife health authorities or public health authorities) aware of the relationship between the loss of vulture populations and associated ecosystem services with increased risk of disease spread among animals, increased feral animal populations, increased risk of human disease and related mortality risks, and reduced natural pest control services.

  - Ensure agencies advise farmers so they are aware of NSAIDs proven to be safe and approved for veterinary use (meloxicam and tolfenamic acid) and actively encourage farmers to only use these two drugs.

  - Educate agencies responsible for waste management laws and management about potential risks associated with livestock carcasses.

- **Education of manufacturers and suppliers of veterinary NSAIDs**.

  - Make decision makers in pharmaceutical companies aware of which compounds are safe (meloxicam and tolfenamic acid), which are known to be toxic to vultures (see above) and which have not yet been tested and should therefore be avoided until safety testing is completed.

  - Promote the use of products containing meloxicam and tolfenamic acid, to enhance uptake by users.

  - Where allowable, encourage marketing to promote the use of products containing meloxicam and tolfenamic acid, including labelling as 'vulture-safe', to increase public awareness.

## B. SURVEILLANCE AND REPORTING OF VULTURE AND SCAVENGING BIRD DEATHS

- **Pharmacovigilance for wildlife:**

  - Actively contribute to monitoring the adverse effects of NSAIDs on **vulture and scavenging raptor** health.

  - Establish mechanism to monitor reports of mortalities associated with NSAIDs toxicity to enable evaluation and evidence to guide regulatory action.

- **Forensic collaboration:**

    - Actively contribute to establishing a system for reporting of dead vultures and scavenging bird mortalities by farmers, veterinarians and the public, and promote prompt collection, post-mortem examination and tissue sampling by appropriately qualified staff (e.g. veterinarians, paraveterinarians, or veterinary nurses/technicians), collaborating with wildlife authorities and laboratories for sampling, and diagnostic investigations, including where indicated, toxicological analysis to identify responsible NSAID(s). This should be followed by efforts from responsible authorities to improve detection and prosecution of vulture and scavenging raptor poisoning incidents. Note: investigation for infectious diseases may be required in advance of toxicity testing.

## Guidance for veterinary and animal health practitioners

**A. Prudent prescription and drug selection**

- **Prioritise proven, safe alternatives: meloxicam** and **tolfenamic acid** are safe, readily available alternatives to diclofenac and other NSAIDs known to be toxic (see table 1), established by safety testing experiments and the preferred option used in all regions where vulture and scavenging raptor populations occur.

- **Avoid veterinary use of toxic NSAIDs:** Discontinue use of diclofenac, aceclofenac, nimesulide, flunixin and ketoprofen for livestock treatment in all the areas inhabited by susceptible vulture and scavenging raptor populations (noting this is near global distribution).

**B. Raise awareness about the toxicity of specific NSAIDs:**

- Provide clear practical guidance to livestock owners on the risk associated with use of vulture-toxic NSAIDs. This includes promoting responsible carcasses management for animals treated with these drugs. Animals that die within the 3-4 day of treatment (e.g. metabolic window) must be disposed of safely and not composted. Safe disposal includes deep burial.

- Provided guidance on selection of suitable, safe carcasses for use at vulture feeding stations, ensuring animals treated with vulture-toxic NSAIDs are never used.

**C. Surveillance and reporting of wildlife deaths**

- Report dead vultures or other scavenging raptors, and seek advice on prompt sample collection and transfer to appropriate pathology laboratories for investigation. Note, investigation for infectious diseases may be required in advance of toxicity testing.

- Report toxicity findings to relevant wildlife health data systems (e.g. African Wildlife Poisoning Database, national wildlife health authority).

## Recommended citation

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WOAH – https://www.woah.org/en/document/the-vulture-emergency-non-steroidal-anti-inflammatory-drug-nsaid-risks-to-health-and-biodiversity/

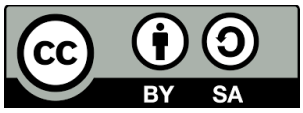
## Reaching out to national and international bodies:

For more information or further consultation, please contact:

CMS - cms-secretariat@un.org
https://www.cms.int/cms-focal-points

WOAH – woah@woah.org
Members - WOAH - World Organisation for Animal Health

IUCN-WHSG - https://iucn.org/our-union/commissions/group/iucn-ssc-wildlife-health-specialist-group



# The Vulture Emergency

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