

# Animal incursions worldwide (2001-2022)

Continent	Incursion location	Incursion date	Species	Origin continent	Location origin	Time between incursion & symptoms	Type of incursion	Borders crossed	Mode of travel	Incursion details	Phylogenetic analysis	Public health response	Local transmission	Unusual cross-species transmission	Reference(s)
Africa	South Africa	Jul-03	Horse	Africa	Zimbabwe	5 months	Human-mediated	International (shared border)	By land	Owned, unvaccinated 2-year-old Thoroughbred; Imported from Golden Acres, Harare to Ashburton Training Center, Pietermaritzburg	No		Sabeta & Randles, 2005 (1)	No local transmission	No
Africa	Ethiopia	Sep-03	Dog	Africa	Ethiopia		Natural	In-country	By land	Presumed unvaccinated; Incursion from nearby towns despite regular mass dog vaccination; caused rabies outbreak in wolves of Bale Mountains National Park	No	Trap-vaccination-release of wolves	Laurenson et al., 2005 (2); McQuiston, 2008 (3); Ehnert & Galland, 2009 (4)	Outbreak	Yes
Africa	South Africa	Aug-05	Dog	Africa	Zimbabwe		Natural	International (shared border)	By land	Suspected incursion due to phylogenetic analysis catalysed by sharp increase in dog rabies cases in Limpopo province	Yes	Mass dog vaccination	Zulu et al., 2008 (5); Sabeta et al., 2011 (6); Townsend et al., 2013 (7)	No local transmission	No
Africa	South Africa	2008	Dog	Africa	South Africa		Natural	In-country	By land	Suspected incursion from Nkomazi indicated by phylogenetic analysis; led to outbreak in other parts of Mpumalanga	Yes		Phahladira et al., 2012 (8)	Outbreak	No
Africa	South Africa	2010	Dog	Africa	South Africa			In-country	By land (presumed)	Imported from KwaZulu-Natal; bit local pet dog in Witpoortjie, south Johannesburg where vaccination rate is low, resulting in outbreak in Gauteng Province	No		Sabeta et al., 2013 (9); Weyer et al., 2020 (10); Ngoepe et al., 2022 (11)	Outbreak	No
Africa	South Africa	2011	Dog	Africa	Lesotho			International (shared border)	By land (presumed)	Suspected incursion into Sisonke district, KwaZulu-Natal indicated by phylogenetic analysis	Yes		Mollentze et al., 2013 (12)	No local transmission	No
Africa	South Africa	2012	Dog	Africa	South Africa		Natural	In-country	By land (presumed)	Suspected incursion from North West Province indicated by phylogenetic analysis; led to jackal rabies outbreak in uThukela, KwaZulu-Natal	Yes		Ngoepe et al., 2022 (11)	No local transmission	No

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Africa	South Africa	2012	Dog	Africa	Lesotho			International (shared border)	By land (presumed)	Rescued stray puppy; suspected incursion indicated by phylogenetic analysis; secondary transmission to 1 human (owner) in Underberg, Sisonke district, KwaZulu-Natal	Yes		Mollentze et al., 2013 (12)	Secondary transmission	No
Africa	Chad	2014	Dog	Africa	Chad		Human-mediated	In-country	By land (presumed)	Suspected human-mediated incursion into N'Djamena from surrounding area indicated by phylogenetic analysis	Yes		Zinsstag et al., 2017 (13)	No local transmission	No
Africa	Tanzania	Sep-16	Dog	Africa	Tanzania			In-country	By water (presumed)	Suspected incursion from Zanzibar indicated by phylogenetic analysis; led to outbreak in Pemba during lapse in dog mass vaccination	Yes	Mass dog vaccination, PEP (subsidized); outbreak ended in 2018	Lushasi et al., 2022 (14)	Outbreak	No
Africa	South Africa	2016	Jackal	Africa	South Africa		Natural	In-country	By land	Suspected incursion from North West Province indicated by phylogenetic analysis; led to outbreak in Gauteng Province	Yes	PEP	Ngoepe et al., 2022 (11)	Outbreak	No
Asia	Iran	Jan-01	Dog	Asia	Nepal	5 days	Human-mediated	International	By air	Owned, unvaccinated prior to importation; vaccinated against rabies following arrival in Iran	No	PEP (owners)	Johnson et al., 2011 (15)	No local transmission	No
Asia	Israel	Mar-03	Dog	Asia	Israel		Human-mediated	In-country	By land	Owned (newly adopted); adopted by owner during trip to Beer Sheva and brought back to residence	No	Contact tracing, PEP, increased public awareness (tourists)	David et al., 2004 (16); David and Yakobson, 2011 (17)	No local transmission	No
Asia	Indonesia	Aug-03	Dog	Asia	Indonesia		Human-mediated	In-country	By water	Owned; imported from Sulawesi to Maluku islands for meat trade	No		Townsend et al., 2013 (7)	No local transmission	No

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Asia	Bhutan	May-05	Dog	Asia	India		Natural	International (shared border)	By land	Free-roaming; bit cow in Gongza village, Toetsho subdistrict, Trashiyangtse, resulting in outbreak that spread to other villages accessible to free-roaming dogs through road network	No	Mass dog vaccination, PEP, dog-catching, vaccination of exposed animals, increased public awareness	Tenzin et al., 2011 (18); Townsend et al., 2013 (7); Rinchen et al., 2020 (19); Rinchen et al., 2020 (20)	Outbreak	Yes
Asia	China	Feb-06	Dog	Asia	China			In-country	By land	Suspected incursion from Hengshan city into Yongzhou city indicated by phylogenetic analysis; resulted in secondary transmission to local free-roaming owned dog, which visited neighbouring farm and attacked pigs, causing outbreak with 20 pig deaths out of >50 exposed as no control measures were initiated	No		Jiang et al., 2008 (21)	Outbreak	Yes
Asia	Bhutan	2007	Dog	Asia	India		Natural	International (shared border)	By land	Incursion into Dala subdistrict, Chhukha, Bhutan	No	Culling; controlled by 2008	Townsend et al., 2013 (7)	No local transmission	No
Asia	Indonesia	2008	Dog	Asia	Indonesia		Human-mediated	In-country	By water	Owned; imported from Flores to Bukit Peninsula, Bali by fishermen with no border controls; bit owners and caused outbreak that spread to other regions with >200 human deaths including owner; delayed detection and response due to poor bite surveillance, non-existent PEP policies, insufficient vaccine stocks and prioritisation of culling	No	Culling, mass dog vaccination	Scott-Orr and Putra, 2009 (22); Clifton, 2010 (23); Batan et al., 2014 (24); Putra et al., 2013 (25); Mahardika et al., 2014 (26); Dibia et al., 2015 (27); Cliquet and Wasniewski, 2018 (28); De Jong et al., 2018 (29); Drake, 2020 (30); Rupprecht et al., 2020 (31); Ward and Brookes, 2021 (32)	Outbreak	No
Asia	Bhutan	2008	Dog	Asia	Bhutan		Natural	In-country	By land	Incursion from south into southwest region	No		Rinchen et al., 2020 (19); Rinchen et al., 2020 (20)	No local transmission	No

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Asia	China	Mar-09	Dog	Asia	China		Human-mediated	In-country	By land	Suspected incursion from Sichuan Province into Hanzhong District, Shaanxi Province indicated by phylogenetic analysis; transport of dogs for meat trade enabled outbreak that resulted in >7,000 biting incidents and 20 human deaths	Yes	Culling, Mass dog vaccination (limited), PEP (limited)	Zhao et al., 2011 (33); Zhang et al., 2014 (34);	Outbreak	No
Asia	Indonesia	Feb-10	Dog	Asia	Indonesia		Human-mediated	In-country	By water	Incursion from Sumatra into Nias; caused 1 human rabies death after biting medical official	No	Culling, mass dog vaccination	Townsend et al., 2013 (7); Rupprecht et al., 2018 (35); Global Alliance for Rabies Control, 2024 (36)	Secondary transmission	No
Asia	China	2010	Dog	Asia	China			In-country	By land	Suspected incursion from Baoding City, Hebei Province into Yangqu County, Shanxi Province indicated by phylogenetic analysis; resulted in secondary transmission to local owned dog which attacked neighbour's sheep, causing outbreak; spread attributed to high numbers of unvaccinated free-roaming dogs	Yes	Quarantine of exposed animals; sacrifice of associated animals (dog, sheep), mandatory vaccination of pets (owned dogs in the vicinity)	Zhu et al., 2011 (37)	Outbreak	Yes
Asia	China	Dec-10	Dog	Asia	China		Natural	In-country	By land	Free-roaming; suspected incursion from Baoding, Hebei Province into Yangqu county, Shaanxi Province indicated by phylogenetic analysis; detected after secondary transmission to dog, which attacked neighbour's sheep and dog; spread due to unvaccinated free-roaming dogs in, lack of border control and meat trade facilitating movement of dogs	Yes	Vaccination of exposed animals (dogs), sacrifice of associated animals (sheep)	Zhang et al., (34)	Secondary transmission	No

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Asia	Russia	Feb-11	Fox	Asia	Mongolia		Natural	International (shared border)	By land, water (frozen)	Suspected incursion into Republic of Buryatia, Russia through crossing of frozen river indicated by phylogenetic analysis; resulted in outbreak	Yes		Adelshin et al., 2012 (38); Adelshin et al., 2015 (39)	Outbreak	No
Asia	Israel	Oct-11	Dog	Asia	Israel	2 months	Human-mediated	In-country	By land (presumed)	Owned, unvaccinated 3-year-old; Brought by owners on camping trip to eastern coast of Sea of Galilee and Northern Israel and stayed outside, was bitten by local rabid stray dog and manifested symptoms after return to Israel; incomplete vaccination record (not rabies)	No	Contact tracing, PEP	David et al., 2012 (40)	No local transmission	No
Asia	Philippines	2011	Dog	Asia	Philippines		Human-mediated	In-country	By water (presumed)	Suspected long-distance migration from Central Luzon region to Tablas Island, Romblon indicated by phylogenetic analysis	Yes		Tohma et al., 2016 (41)	No local transmission	No
Asia	Russia	Feb-12	Fox	Asia	Mongolia		Natural	International (shared border)	By land, water (frozen)	Suspected incursion into Republic of Buryatia, Russia through crossing of frozen river, indicated by phylogenetic analysis	Yes		Adelshin et al., 2015 (39)	No local transmission	No
Asia	South Korea	Apr-13	Dog	Asia	South Korea		Natural	In-country	By land	Suspected incursion from Gangwon Province into Gyeonggi Province indicated by phylogenetic analysis;	Yes		Oem et al., 2014 (42)	No local transmission	No

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Asia	Israel	Sep-13	Cow	Asia	Israel	2 weeks	Human-mediated	In-country	By land	Suspected infection by by jackal that had been shot in the vicinity and tested positive for rabies; 3 among group of >50 dairy calves transported from dairy farm in Golan Heights, Kibbutz Ortal to Bet Zaid Village, Emek Izrael, Jezreel Valley; 2 out of 3 later transported to Kfar Yehoshua	No		David et al., 2015 (43)	No local transmission	No
Asia	China	2014	Red fox	Asia	Russia or Mongolia		Natural	International (shared border)	By land	Suspected incursion into Inner Mongolia Autonomous Region (IMAR), China indicated by phylogenetic analysis; resulted in secondary transmission to cow	Yes		Liu et al., 2014 (44)	Secondary transmission	Yes
Asia	China	2014	Raccoon dog	Asia	Russia or Mongolia		Natural	International (shared border)	By land	Suspected incursion into Heilongjiang Province, China indicated by phylogenetic analysis; resulted in secondary transmission to goat	Yes		Liu et al., 2014 (44)	Secondary transmission	Yes
Asia	Malaysia	2015	Dog	Asia	Thailand			International (shared border)	By land	Suspected incursion into Perlis, Malaysia indicated by phylogenetic analysis	Yes		Leow et al., 2021 (45)	No local transmission	No
Asia	Malaysia	2015	Dog	Asia	Thailand			International (shared border)	By land	Suspected incursion into Kedah, Malaysia indicated by phylogenetic analysis	Yes		Leow et al., 2021 (45)	No local transmission	No

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Asia	Bhutan	Oct-16	Dog	Asia	Bhutan		Natural	In-country	By land	Stray, free-roaming; incursion from Meral and Sakteng subdistricts into Rangjung town, Trashigang; bit 3 humans and caused outbreak with >20 infected animals (dogs, cattle, cat); spread facilitated by large stray dog population and lack of public health response, as cases were previously detected in neighboring villages 2-3 months prior	No	PEP	Tenzin et al., 2017 (46)	Outbreak	Yes
Asia	India	Feb-16	Jackal	Asia	India		Natural	In-country	By land	Incursion from West Bengal into Sikkim; bit 2 cows, causing secondary transmission; suspected infection by free-roaming dog while searching for food during winter, as dog vaccination coverage is low due to cultural beliefs that dogs should not be touched	No		Byrnes et al., 2017 (47)	Secondary transmission	Yes
Asia	Malaysia	Jul-17	Dog	Asia	Indonesia		Human-mediated	International (shared border)	By land	Suspected incursion from West Kalimantan, Indonesia into Serian, Sarawak, Malaysia indicated by phylogenetic analysis; Attributed to workers bringing dogs during construction of Pan Borneo Highway; bit 2 children; spread facilitated by minimal rabies control at border and interaction of owned and stray dogs, resulting in outbreak	Yes	Culling, mass dog vaccination, PEP	Rupprecht et al., 2018 (35); Taib et al., 2019 (48); Leow et al., 2021 (45); Ward and Brookes, 2021 (32); Global Alliance for Rabies Control, 2024 (36)	Outbreak	No
Asia	Indonesia	2019	Dog	Asia	Indonesia		Human-mediated	In-country	By water	Owned; brought from Bali or Sulawesi to Sumbawa Island to guard corn crops from wild monkeys	No		Ward and Brookes, 2021 (32)	No local transmission	No

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Europe	France	Mar-01	Dog	Africa	Morocco (via Spain)	7 weeks	Human-mediated	Intercontinental, International (shared border)	By land, air/water (presumed)	Owned, 3-month-old puppy; adopted by owners during camping trip in Morocco and imported to Langon, Gironde, France by driving through Spain; no border controls observed for rabies (FMD only); delayed reporting of contact with another dog by owners, resulting in fine for withholding information	No	Contact tracing, PEP, quarantine, controlled movement of dogs, sacrifice of associated animals (dog)	Bruyere-Masson et al., 2001 (49); Ribadeau-Dumas, 2016 (50); Alvarez et al., 2022 (51)	No local transmission	No
Europe	Albania	Mar-01	Dog	Europe	Kosovo		Natural	International (shared border)	By land	Migrated to Morine, Kukesi Province and bit 3 humans; suspected infection by wild animal (wolf/fox) as no ORV along border	No	PEP	WHO Collaborating Centre for Rabies Surveillance and Research, 2001 (52); Blanton et al., 2007 (53); Korro et al., 2009 (54); Lika, 2010 (55)	No local transmission	No
Europe	Austria	Oct-01	Dog	Europe	Serbia		Human-mediated	International	By land (presumed)	Owned, two-month-old puppy; illegally imported from Belgrade, Serbia to Vienna, Austria and sold to new owners	No	PEP, contact tracing, quarantine of exposed animals (dogs), sacrifice of associated animals (second dog of owners)	Office International des Epizooties, 2001 (56); McElhinney et al., 2011 (57)	No local transmission	No
Europe	Germany	Nov-01	Dog	Asia	Azerbaijan	2 days	Human-mediated	Intercontinental	By air	Owned, 1-month-old, recently vaccinated puppy; adopted by worker in Azerbaijan, vaccinated and given health certificate without time for rabies antibodies to develop before importation to Bavaria, Germany	No	PEP, contact tracing	WHO Collaborating Centre for Rabies Surveillance and Research, 2001 (58); Johnson et al., 2011(15); Ribadeau-Dumas, 2016 (50); Alvarez et al., 2022 (51)	No local transmission	No
Europe	Germany	2001	Dog	Asia	Nepal		Human-mediated	Intercontinental	By air	Owned; imported	No		Cliquet and Wasniewski, 2018 (28)	No local transmission	No
Europe	Austria	Jan-02	Fox	Europe	Slovenia		Natural	International (shared border)	By land	Incursion into Carinthia, Austria; caused outbreak resulting in >20 rabid animals	No	ORV	Potsch, 2014 (59); Singh et al., 2018 (60)	Outbreak	No



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Europe	France	2002	Dog	Africa	Morocco (via Spain)	7 weeks	Human-mediated	Intercontinental	By land, air/water (presumed)	Owned, unvaccinated 3-month-old puppy; illegally imported to Seine Saint Denis, France without vaccination certificate	No	PEP	WHO Collaborating Centre for Rabies Surveillance and Research, 2001 (58); Lardon, 2010 (61); Johnson et al., 2011 (15); Mailles et al., 2011 (62); Ribadeau-Dumas, 2016 (50); Alvarez et al., 2022 (51)	No local transmission	No
Europe	Switzerland	May-03	Dog	Africa	Algeria or Morocco	1 month	Human-mediated	Intercontinental		Owned, <1-month old puppy; suspected to have been illegally imported and abandoned in Nyon, Geneva, Switzerland; found and brought to animal shelter, later adopted	No	PEP, vaccination of exposed animals	Zanoni and Breitenmoser, 2003 (63); Johnson et al., 2011 (15); Ribadeau-Dumas, 2016 (50);	No local transmission	No
Europe	Finland	Jun-03	Horse	Europe	Estonia	1 month	Human-mediated	International	By land/water	Owned, unvaccinated 2-year-old; imported without vaccination, in accordance with local guidelines (rabies vaccination recommended but not required, contrary to OIE standards); was released to pasture with other horses; bit veterinarian during examination	No	PEP (veterinarian), vaccination of exposed animals (horses), quarantine of exposed animals (horses)	Englund and Pringle, 2003 (64); Rimhanen-Finne et al., 2009 (65); Metlin et al., 2016 (66); Zoonosikeskus (Zoonoses Centre), 2012 (67); Dominguez et al., 2016 (68)	No local transmission	No
Europe	France	2004	Dog	Africa	Morocco (via Spain)		Human-mediated	Intercontinental, International (shared border)	By land, air/water (presumed)	Owned, vaccinated 4-year-old; illegally imported via Melilla, Spain to Lorient, France	No	PEP	Servas et al., 2005 (69); Lardon, 2010 (61); Ribadeau-Dumas, 2016 (50)	No local transmission	No
Europe	France	May-04	Dog	Africa	Morocco (via Spain)		Human-mediated	Intercontinental, International (shared border)	By land, air/water (presumed)	Owned, unvaccinated 6-month-old; illegally imported via Spain to St. Gery, France	No	Contact tracing, PEP	Servas et al., 2005 (69); Lardon, 2010 (61); Ribadeau-Dumas, 2016 (50)	No local transmission	No

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Europe	France	Jul-04	Dog	Africa	Morocco (via Spain)	1 month	Human-mediated	Intercontinental, International (shared border)	By land, air/water (presumed)	Owned, unvaccinated 4-month-old puppy; Illegally imported, brought by owner through Ceuta, Spain, to Gironde, Aquitaine, Bordeaux France in car but allowed to roam unleashed at 3 summer music festivals, exposing >150 humans	No	Culling (free-roaming dogs only) Contact tracing (hotline established), PEP, monitoring of animals	Health Protection Agency, 2005 (70); Servas et al., 2005 (69); Lardon, 2010 (61); Ribadeau-Dumas, 2016 (50); Alvarez et al., 2022 (51)	No local transmission	No
Europe	France	2004	Dog	Africa	Morocco (via Spain)		Human-mediated	Intercontinental, International (shared border)	By land (presumed), air/water (presumed)	Owned; illegally imported to Gironde, France	No		Johnson et al., 2011 (15); Alvarez et al., 2022 (51)	No local transmission	No
Europe	France	2004	Dog	Africa	Morocco (via Spain)		Human-mediated	Intercontinental, International (shared border)	By land (presumed), air/water (presumed)	Owned, 4-year-old; illegally imported to Finistère, France despite lacking pet passport	No	PEP	Johnson et al., 2011 (15); Mailles et al., 2011 (62); Alvarez et al., 2022 (51)	No local transmission	No
Europe	Germany	2004	Dog	Africa	Morocco	27 days	Human-mediated	Intercontinental	By air	Owned, unvaccinated 8-month-old; imported without complete travel requirements (no vaccination, pet passport or health certificate), but import permission was requested and granted under condition of vaccination and quarantine at owner's house in Germany; dog died in quarantine in Hannover	No	PEP, contact tracing, sacrifice of associated animals with confirmed direct exposure (cat), vaccination of associated animals (dogs)	Johnson et al., 2011 (15); Ribadeau-Dumas, 2016 (50); Alvarez et al., 2022 (51)	No local transmission	No
Europe	Germany	Jan-05	Fox	Europe	Germany		Natural	In-country	By land	Incursion from Hesse to Rhineland-Palatinate after ORV preventive vaccination cordon	No	ORV (changed from baits to aerial, at 6-week intervals instead of every autumn)	Selhorst et al., 2012 (71); Cliquet and Wasniewski, 2018 (28)	No local transmission	No
Europe	Spain	2005	Dog	Africa	Morocco		Human-mediated	Intercontinental (shared border)	By land	Owned; imported to Melilla, Spain	No		European Food Safety Authority, 2007 (72)	No local transmission	No

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Europe	France	Oct-07	Dog	Africa	Morocco (via Portugal and Spain)	15 days	Human-mediated	Intercontinental, International (shared border)	By water, land	Owned, recently vaccinated adult; imported despite visible injuries and short duration between rabies vaccination and travel; brought by owner to beach in Portugal, then passed Spain on the way to Grandpuits, Seine-et-Marne, Hautes-Pyrénées, Ger, France; In direct contact with 1 dog, which later associated with 1 other dog; resulted in secondary transmission to 1 dog, with France losing rabies-free status for 2 years	No	Contact tracing, PEP	Eurosurveillance, 2008 (73); Gautret et al., 2011 (74); Johnson et al., 2011 (15); Ribadeau-Dumas, 2016 (50); Yamada et al., 2019 (75); Alvarez et al., 2022 (51)	Secondary transmission	No
Europe	Belgium	Oct-07	Dog	Africa	Morocco	1 month	Human-mediated	Intercontinental	By air/water (presumed)	Owned (newly-adopted), unvaccinated 1-month-old puppy; adopted by owner while on vacation in Morocco and imported to Beersel, Brussels, Belgium; checked by Morocco veterinarian and cleared for importation despite not fulfilling rabies vaccination and serology requirements; owners not informed of pet passport, resulting in smuggling of dog on plane in handbag; no border control measures observed; checked by 2nd veterinarian in Belgium but not vaccinated for rabies; brought to dog park; resulted in Belgium losing rabies-free status for 6 months	No	Contact tracing, PEP, 6-month quarantine (visitor dogs at dog park), sacrifice of associated pets, recommended pet vaccination, enhanced surveillance, restrictions, active fox surveillance, mandatory dog leashing	European Food Safety Authority, 2007 (72); Van Gucht and Le Roux , 2008 (76); Ehnert & Galland, 2009 (4); Johnson et al., 2011 (15); Ribadeau-Dumas, 2016 (50); Alvarez et al., 2022 (51)	No local transmission	No
Europe	Kosovo	Oct-07	Fox	Europe	Republic of North Macedonia		Natural	International (shared border)	By land	Incursion into Štrpca, Kosovo; 1 fox found near police station, 1 fox found near holding	No		Muji et al., 2012 (77)	No local transmission	No

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Europe	Germany	2007	Dog	Africa	Morocco		Human-mediated	Intercontinental	By air/water (presumed)	Owned; illegally imported	No		Ehnert & Galland, 2009 (4)	No local transmission	No
Europe	Finland	2007	Dog	Asia	India	<1 month	Human-mediated	Intercontinental	By air	Owned, formerly free-roaming, recently vaccinated puppy born to stray dog; rescued from streets in India while attacked by stray dog; vaccinated <30 days before importation to Finland	No	PEP	European Food Safety Authority, 2009; Johnson et al., 2011 (15); Zoonoosikeskus (Zoonoses Centre), 2012 (67); Väyrynen, 2020 (78)	No local transmission	No
Europe	France	Apr-08	Dog	Africa	Gambia (via Senegal and Belgium)	2 weeks	Human-mediated	Intercontinental, International (shared border)	By air, land	Owned (newly-adopted), microchipped, vaccinated 6-month-old; adopted in Gambia; fulfilled all travel requirements for except serology; wounded but given health certificate; imported to Uccle, Belgium, brought into passenger cabin of plane; driven to France	No	Contact tracing, PEP, 6-month quarantine of exposed animals (cats)	Eurosurveillance, 2008 (79); Roux and Gucht, 2008 (80); European Food Safety Authority, 2010 (81); Ribadeau-Dumas, 2016 (50); Cliquet and Wasniewski, 2018 (28); Alvarez et al., 2022 (51)	No local transmission	No
Europe	United Kingdom	Apr-08	Dog	Asia	Sri Lanka	6 days	Human-mediated	Intercontinental	By air	Owned, vaccinated 10-week-old puppy; imported by rescue group along with >10 animals despite not meeting minimum age requirement for travel; quarantined in Chingford Kennels, Heathrow, London where symptoms manifested	No	Contact tracing, PEP, sacrifice of associated animals (nearby dogs at quarantine center)	Catchpole et al., 2008 (82); Fooks et al., 2008 (83); Goddard et al., 2008 (84); Health Protection Agency, 2008 (85); WHO Collaborating Centre for Rabies Surveillance & Research, 2009 (86); European Food Safety Authority, 2010 (81); Johnson et al., 2011 (15); Johnson et al., 2011 (87); Fooks and Johnson, 2015 (88); Ribadeau-Dumas, 2016 (50); Alvarez et al., 2022 (51)	No local transmission	No

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Europe	Germany	Jun-08	Dog	Europe	Croatia	6 months	Human-mediated	International	By land	Owned, unvaccinated 6-week-old puppy; illegally imported to animal shelter in Lörrach, Baden-Württemberg, Germany without vaccination certificate; no border control measures reported at EU border	No	Contact tracing, PEP, quarantine of exposed animals	Johnson et al., 2011 (15); Weiss et al., 2009 (89); European Food Safety Authority, 2010 (81); Ribadeau-Dumas, 2016 (50); Alvarez et al., 2022 (51)	No local transmission	No
Europe	France	Oct-08	Dog	Europe	Spain	1 month	Human-mediated	International	By land	Owned (newly adopted); found in car park in Malaga, Spain; transported by owner to Saint André-le-Gaz, France by car	No	Contact tracing	Johnson et al., 2011 (15);	No local transmission	No
Europe	Italy	Oct-08	Red fox	Europe	Slovenia		Natural	International (shared border)	By land	Incursion into Venzone, Udine, Italy; 1 fox bit 1 human, and caused rabies spread to other regions; ORV not maintained during that period	No	PEP, ORV (Emergency)	De Benedictis et al., 2008 (90); Fusaro et al., 2013 (91); Berg et al, 2015 (92); Rupprecht et al., 2020 (31); Kumar et al., 2021 (93); Lojkić et al., 2021 (94)	Outbreak	No
Europe	Italy	Nov-08	Fox	Europe	Italy		Natural	In-country	By land	Continued incursion from Italy into Belluno, Venzone Province following Udine incursion from Slovenia; caused rabies spread to other regions	No	PEP, ORV (Emergency)	Fusaro et al., 2013 (91); Berg et al, 2015 (92); Rupprecht et al., 2020 (31); Kumar et al., 2021 (93); Lojkić et al., 2021 (94)	Outbreak	No
Europe	France	2008	Dog	Europe	Spain	18 days	Human-mediated	International (shared border)	By land, air/water (presumed)	Owned, recently adopted, unvaccinated 3-month-old puppy; found on highway in Spain and illegally imported to Isère, France; suspected incursion from Morocco indicated by phylogenetic analysis	Yes	PEP	Mailles et al., 2011 (62); Alvarez et al., 2022 (51)	No local transmission	No
Europe	Germany	2009	Dog	Europe	Croatia		Human-mediated	International	By land	Owned, juvenile; imported; no border control measures reported	No		Tietjen et al., 2011 (95)	No local transmission	No
Europe	France	2009	Dog	Asia	Afghanistan		Human-mediated	Intercontinental	By air	Owned; imported	No		WHO Collaborating Centre for Rabies Surveillance & Research, 2009 (96); Johnson et al., 2011 (15)	No local transmission	No

Continent	Incursion location	Incursion date	Species	Origin continent	Location origin	Time between incursion & symptoms	Type of incursion	Borders crossed	Mode of travel	Incursion details	Phylogenetic analysis	Public health response	Local transmission	Unusual cross-species transmission	Reference(s)
Europe	Germany	Feb-10	Dog	Europe	Bosnia and Herzegovina (via Slovenia)	22 days	Human-mediated	International (shared border)	By land	Owned (newly bought), unvaccinated, 2-month-old puppy; imported to Neustadt an der Aisch, Bavaria, Germany; incomplete travel documents (no record of rabies vaccination) but allowed through border control; history of biting by aggressive dog	No	Contact tracing, PEP, destroyed associated animals (unvaccinated cats)	Eismann et al., 2011 (97); Johnson et al., 2011 (15); European Food Safety Authority and European Centre for Disease Prevention and Control, 2012 (98); Ribadeau-Dumas, 2016 (50); Alvarez et al., 2022 (51)	No local transmission	No
Europe	Poland	2010	Fox	Europe	Belarus or Ukraine		Natural	International (shared border)	By land	Incursion into Rzeszow, Poland	No	ORV	Smreczak et al., 2012 (99)	No local transmission	No
Europe	Poland	2010	Fox	Europe	Belarus or Ukraine		Natural	International (shared border)	By land	Incursion into Lublin, Poland	No	ORV	Smreczak et al., 2012 (99)	No local transmission	No
Europe	Poland	2010	Fox	Europe	Russia or Ukraine		Natural	International (shared border)	By land	Incursion into Malopolskie region, Poland; caused outbreak, resulting from weak surveillance (minimal sample collection)	No	ORV (maintained)	Berg et al, 2015 (92); Ortiz et al., 2018 (100)	Outbreak	No
Europe	France	Jul-11	Dog	Africa	Morocco (via Spain)	4 days	Human-mediated	Intercontinental, International (shared border)	By water, land	Owned (newly adopted) unvaccinated, 3-month-old puppy; Illegally imported to Vendée, France; did not fulfil all travel requirements (underage, unvaccinated, not microchipped, no travel certificate)	No	Contact tracing, PEP, (booster) vaccination of exposed animals (dogs), sacrifice of associated animals (cats)	Mailles et al., 2011 (62); Roberts and Lopez, 2011 (101); European Food Safety Authority and European Centre for Disease Prevention and Control, 2013 (102); Alvarez et al., 2022 (51)	No local transmission	No
Europe	Norway	2011	Arctic fox	Europe	Norway		Natural	In-country	By water (frozen)	Incursion from Svalbard mainland into Hopen Island by crossing frozen sea ice during winter; attacked 4 dogs at Hopen Metereological Station, killed by dog	No	(Booster) vaccination of exposed animals (dogs)	Roberts et al., 2011 (103)	No local transmission	No

Continent	Incursion location	Incursion date	Species	Origin continent	Location origin	Time between incursion & symptoms	Type of incursion	Borders crossed	Mode of travel	Incursion details	Phylogenetic analysis	Public health response	Local transmission	Unusual cross-species transmission	Reference(s)
Europe	Croatia	2011	Cow	Europe	Romania	8 months	Human-mediated	International	By land	Owned, unvaccinated; one of 1,000 cows imported from Brasov, Romania to Osje ko-Baranjska county, Croatia with valid documents (health certificates) but no rabies vaccination required; 6 bulls exhibited symptoms	No	Sacrifice of associated animals (bulls in same box)	Lojkić et al., 2013 (104)	No local transmission	No
Europe	Norway	2011	Arctic fox	Europe	Russia		Natural	International	By water (frozen)	Incursion into Svalbard, Norway by crossing frozen sea ice	No		Simon et al., 2021 (105); Hueffer, 2022 (106)	No local transmission	No
Europe	Poland	2011	Fox	Europe	Russia		Natural	International	By land	Incursion from Kaliningrad Oblast, Russia into Warminsko-Mazurskie, Poland	No	ORV (intensified)	Berg et al, 2015 (92)	No local transmission	No
Europe	Netherlands	Feb-12	Dog	Africa	Morocco (via Spain)	1 day	Human-mediated	Intercontinental, International	By air, land/water (presumed)	Owned (newly bought) unvaccinated 2-month-old puppy; purchased in parking lot and illegally imported from Morocco to Amsterdam, Netherlands via Spain; examined at customs but pet passport and vaccination status not checked; stayed in passenger cabin of plane	No	Contact tracing, PEP, (booster) vaccination of exposed animals (dogs), sacrifice of associated animals (cats) due to lack of available venue for quarantine	Roberts and Lopez, 2012 (107); Van Rijkevorsse et al., 2012 (108); Ribadeau-Dumas, 2016 (50); Veda et al., 2021 (109); Alvarez et al., 2022 (51)	No local transmission	No
Europe	Greece	Oct-12	Red fox	Europe	Republic of North Macedonia		Natural	International (shared border)	By land	Incursion into West Macedonia Region (Kozani Regional Unit), Greece; observed with symptoms by villagers; led to secondary transmission to 6 foxes and 2 dogs; spread attributed to neglect of ORV and lack of mountains	No	ORV, improved passive surveillance, mandatory pet vaccination, increased public awareness	Tsiodras et al., 2013 (110); Tsiodras et al., 2014 (111); Giannakopoulos et al., 2016 (112); Rupprecht et al., 2020 (31); Lojkić et al., 2021 (94)	Secondary transmission	Yes

Continent	Incursion location	Incursion date	Species	Origin continent	Location origin	Time between incursion & symptoms	Type of incursion	Borders crossed	Mode of travel	Incursion details	Phylogenetic analysis	Public health response	Local transmission	Unusual cross-species transmission	Reference(s)
Europe	Spain	Jun-13	Dog	Africa	Morocco	2 months	Human-mediated	Intercontinental	By land, air/water (presumed)	Owned, recently vaccinated 4-year-old; attempted importation to Morocco 4 months prior but denied due to lack of serology test; transported from Spain to Morocco by owner immediately after vaccination; illegally imported (suspected entry point through Ceuta) back to Argés, Toledo, Castilla-La; owners did not have permanent home and were living in van; escaped, attacked 5 humans and died, resulting in loss of rabies-free status in Spain for 6 months; owners fined for not disclosing all information	No	Contact tracing, PEP, mandatory pet vaccination (animals in Castilla-La Mancha (114); Ribadeau-restriction area), serology of all exposed dogs, sacrifice of associated animals (dog with insufficient antibodies according to serology), restricted animal movement	Suarez-Rodriguez et al., 2013 (113); Pérez de Diego et al., 2015 (114); Ribadeau-Dumas, 2016 (50); Veda et al., 2021 (109); Alvarez et al., 2022 (51)	No local transmission	No
Europe	France	Oct-13	Cat	Africa	Morocco	11 days	Human-mediated	Intercontinental	By air	Owned (newly adopted), unvaccinated 2-month-old kitten; imported from Morocco to Val d'Oise, France with certificate of good health despite not meeting qualifications for importation; escaped home and was adopted twice by different owners	No	Contact tracing, PEP, monitoring of vaccinated animals, sacrifice of associated animals (non-vaccinated), restricted movement of pets, increased surveillance	Veterinary Record, 2013 (115); Ribadeau-Dumas, 2016 (50)	No local transmission	No
Europe	Slovakia	2013	Dog, fox, marten	Europe	Poland		Natural	International (shared border)	By land	Incursion despite ORV	No	ORV (continued)	Ondrejková et al., 2020 (116)	No local transmission	No



Continent	Incursion location	Incursion date	Species	Origin continent	Location origin	Time between incursion & symptoms	Type of incursion	Borders crossed	Mode of travel	Incursion details	Phylogenetic analysis	Public health response	Local transmission	Unusual cross-species transmission	Reference(s)
Europe	France	May-15	Dog	Europe	Algeria	9 days	Human-mediated	International	By air/land (presumed)	Owned, unvaccinated 7-month-old; illegally imported from Hungary to Loire, Rhone-Alpes region, France as a puppy without fulfilling travel requirements (vaccination, identification, underage); brought to Algeria 4 months later by owners despite surveillance orders, escaped for a period; manifested symptoms after return to France and had direct contact with 9 humans and 1 dog	No	Contact tracing, PEP, sacrifice of associated animals (unvaccinated), monitoring of vaccinated animals (dogs) for 6 months, catching of stray animals, restricted movement of pets, increased surveillance	European Food Safety Authority and European Centre for Disease Prevention and Control, 2015 (117); Veterinary Record, (2015) (118); Veda et al., 2021 (109); Alvarez et al., 2022 (51)	No local transmission	No
Europe	Slovakia	2015	Fox	Europe	Poland		Natural	International (shared border)	By land		No	ORV	Ondrejková et al., 2020 (116)	No local transmission	No
Europe	United Kingdom	Jan-20	Sable	Europe	Russia (via Italy)		Human-mediated	International	By air (presumed)	Owned; imported to Riverstick, Ireland	No		European Food Safety Authority and European Centre for Disease Prevention and Control, 2021 (119)	No local transmission	No
Europe	France	Feb-20	Dog	Africa	Morocco		Human-mediated	Intercontinental	By air/water (presumed)	Owned, unvaccinated, 3-month-old puppy; illegal importation	No	PEP	Bacigalupo et al., 2022 (120); European Food Safety Authority and European Centre for Disease Prevention and Control, 2021 (119); Veda et al., 2021 (109); Alvarez et al., 2022 (51)	No local transmission	No
Europe	Poland	Jan-21	Fox	Europe	Belarus or Ukraine		Natural	International (shared border)	By land	Incursion into farmyard in Izabela, Otwock, Mazowieckie voivodeship. Poland; observed to be 'sick', killed by dog; spread facilitated by limitation of ORV to borders only	No	Increased public awareness, increased rabies surveillance, hunting ban, cancellation of pet-centric events, mandatory leashing of dogs, emergency ORV	Smreczak et al., 2023 (121)	No local transmission	No
Europe	Germany	Jul-21	Dog	Asia	Republic of Türkiye (via Bulgaria)	11 days	Human-mediated	Intercontinental, international	By air (presumed)	Owned, unvaccinated, 2-month-old puppy; illegally imported to Lower Saxony, Germany	No	Contact tracing, PEP	Alvarez et al., 2022 (51); European Food Safety Authority and European Centre for Disease Prevention and Control, 2022 (122)	No local transmission	No

Continent	Incursion location	Incursion date	Species	Origin continent	Location origin	Time between incursion & symptoms	Type of incursion	Borders crossed	Mode of travel	Incursion details	Phylogenetic analysis	Public health response	Local transmission	Unusual cross-species transmission	Reference(s)
Europe	France	Oct-22	Dog	Europe	Morocco		Human-mediated	Intercontinental	By air/water (presumed)	Owned, 4-year-old; Suspected illegal importation to shelter in Évry-Courcouronnes, Essonne, Île-de France region, France; bit several humans	No	Contact tracing, PEP, monitoring of shelter	Bacigalupo et al., 2022 (120)	No local transmission	No
North America	United States of America	2001	Raccoon	North America	United States of America		Natural	In-country	By land	Incursion from Pennsylvania into Ohio despite immune corridor from ORV; attributed to weakened surveillance	No	ORV (expanded)	Krebs et al., 2002 (123)	No local transmission	No
North America	Canada	Dec-02	Arctic fox	Europe	Greenland		Natural	Intercontinental	By water (frozen)	Incursion from Greenland into Newfoundland, Canada by crossing through packed ice during winter, indicated by phylogenetic analysis	Yes		Nadin-Davis et al., 2008 (124)	No local transmission	No
North America	Canada	2002	Fox	North America	Canada		Natural	In-country	By water (frozen)	Incursion from mainland Labrador to Cartwright, Labrador by crossing through packed ice; overlap with red fox populations facilitated spread in arctic foxes	No		Nadin-Davis et al., 2008 (124)	No local transmission	No
North America	United States of America	2003	Dog	North America	United States of America		Human-mediated	In-country	By air	Owned; imported into Massachusetts	No	PEP	Lankau et al., 2014 (125)	No local transmission	No
North America	United States of America	Mar-04	Dog	North America	Mexico		Natural	International (shared border)	By land	Incursion into Webb County, Texas	No	Mass dog vaccination, ORV, monitoring	Blanton et al., 2007 (53)	No local transmission	No
North America	United States of America	Jun-04	Dog	Asia	Thailand	2 days	Human-mediated	Intercontinental	By air	Owned (newly adopted) unvaccinated 3-month old puppy; imported to Los Angeles, California; given health certificate despite history of respiratory illness; stayed in passenger cabin	No	Contact tracing, PEP	Castrodale et al., 2008 (126); McQuiston, 2008 (3); Ehnert & Galland, 2009 (4); Lankau et al., 2014 (125)	No local transmission	No
North America	United States of America	Jul-04	Raccoon	North America	United States of America		Natural	In-country	By land	Suspected incursion from mid-Atlantic state to Ohio (although phylogenetic analysis indicates earlier occurrence); detected despite weakened surveillance, limited testing	Yes	ORV, enhanced surveillance	Russell et al., 2005 (127); Henderson et al., 2008 (128); Slate et al., 2008 (129)	No local transmission	No

Continent	Incursion location	Incursion date	Species	Origin continent	Location origin	Time between incursion & symptoms	Type of incursion	Borders crossed	Mode of travel	Incursion details	Phylogenetic analysis	Public health response	Local transmission	Unusual cross-species transmission	Reference(s)
North America	United States of America	2004	Raccoon	North America	United States of America		Natural	In-country	By land	Incursion into Barnstable, Cape Cod from nearby areas in Massachusetts; crossed vaccine barrier, resulting in epizootic	No		Wang et al., 2009 (130)	No local transmission	No
North America	United States of America	Feb-06	Red fox	North America	United States of America		Natural	In-country	By land	Incursion from mid-Atlantic state to Tennessee; found during enhanced surveillance in non-ORV area; suspected infection by raccoon, indicated by phylogenetic analysis; ORV not recommended, considered 'waste of resources'	Yes	Enhanced surveillance (increased sampling)	Slate et al., 2008 (129)	No local transmission	No
North America	Canada	Jun-06	Raccoon	North America	United States of America		Natural	International (shared border)	By land	Incursion from Vermont to Monteregie region, Dunham, Brome-Missisquoi, Quebec, Canada		ORV	Shwiff et al., 2013 (131); Stevenson et al., 2016 (132); Trewby et al., 2017 (133); Nadin-Davis, 2018 (134); Nadin-Davis et al., 2020 (135)	No local transmission	No
North America	United States of America	Mar-07	Dog	Asia	India	2 days	Human-mediated	Intercontinental, in-country	By air	Owned (newly adopted), unvaccinated 11-week-old puppy; imported from New Delhi, India to Seattle, Washington by volunteer veterinarian; given to 2nd veterinarian; despite symptoms and biting history (veterinarian owner, dog), health certificate obtained from 3rd veterinarian for travel to Juneau, Alaska	No	PEP, contact tracing, sacrifice of associated pets (dog)	Blanton et al., 2008 (136); Castrodale et al., 2008 (126); Ehnert & Galland, 2009 (4); Lankau et al., 2014 (125)	No local transmission	No

Continent	Incursion location	Incursion date	Species	Origin continent	Location origin	Time between incursion & symptoms	Type of incursion	Borders crossed	Mode of travel	Incursion details	Phylogenetic analysis	Public health response	Local transmission	Unusual cross-species transmission	Reference(s)
North America	United States of America	2008	Dog	Asia	Iraq	3 days	Human-mediated	Intercontinental	By air	Owned, free-roaming, recently vaccinated 11-month-old; adopted by soldier and kept on military base for 7 months before vaccination and importation; transported with >20 dogs with no vaccination certificates to New Jersey, USA, leading to 30-day quarantine for all animals; diagnosed in quarantine centre	No	Contact tracing, PEP, vaccination of associated animals (dogs, cat); 6-month quarantine of exposed animals (dogs, cat)	Mangieri et al., 2008 (137); Lankau et al., 2014 (125); Hercules et al., 2018 (138)	No local transmission	No
North America	United States of America	Jan-10	Cow	North America	Mexico	5 months	Human-mediated	International (shared border)	By land	Owned, presumed unvaccinated; imported from Mexico to Texas, USA without documentation; suspected infection by vampire bat, indicated by phylogenetic analysis	Yes		Blanton et al., 2011 (139); Pieracci et al., 2020 (140)	No local transmission	No
North America	United States of America	Jan-13	Raccoon	North America	United States of America		Natural	In-country	By land	Incursion from mainland Georgia to Jekyll Island by crossing bridge; associated with 2013 - 2017 epizootic	No		Ortiz et al., 2018 (100)	No local transmission	No
North America	Canada	Jul-13	Dog	North America	Canada	1 month	Human-mediated	In-country	By air	Owned (newly adopted), unvaccinated 5-month-old husky; found in area with ongoing outbreak, scavenging for food with other dogs (mother and newborn litter); imported from Nunavut, Quebec to Calgary, Alberta with layover in Edmonton; no vaccination requirement for in-country travel; suspected infection by arctic fox, indicated by phylogenetic analysis	Yes	PEP, quarantine of exposed animals (mother and litter dogs), sacrifice of associated animals (dog negative for rabies but euthanized at request of owner)	Curry et al., 2016 (141)	Outbreak	Yes

Continent	Incursion location	Incursion date	Species	Origin continent	Location origin	Time between incursion & symptoms	Type of incursion	Borders crossed	Mode of travel	Incursion details	Phylogenetic analysis	Public health response	Local transmission	Unusual cross-species transmission	Reference(s)
North America	Canada	Dec-14	Dog	North America	Canada	0 days	Human-mediated	In-country	By air, land	Owned, unvaccinated <1 year-old; found in construction work camp in Nunavut, Quebec and imported to Edmonton with layover in Yellowknife, Northwest Territories; further travel by car to Saskatoon Health Region, Saskatchewan; no vaccination requirement for in-country travel; manifested symptoms during travel and bit owner; suspected infection by arctic fox, indicated by phylogenetic analysis	Yes	PEP, vaccination of exposed animal (dog), 45-day quarantine of exposed animal (dog)	Curry et al., 2016 (141)	No local transmission	No
North America	United States of America	May-15	Dog	Africa	Egypt	4 days	Human-mediated	Intercontinental	By air	Owned (newly adopted), presumed vaccinated adult female with 1 puppy; found on street in Cairo, Egypt and imported to Virginia, USA by animal rescue organization along with >30 pets (dogs, cats) despite fracture injury; transported in same crate with own puppy; falsified vaccination certificate	No	Contact tracing, PEP, vaccination of exposed animals (puppy, booster for vaccinated dogs), quarantine of exposed dogs (puppy)	Sinclair et al., 2015 (142); Pieracci et al., 2020 (140); Latzer et al., 2022 (143)	No local transmission	No
North America	Canada	Dec-15	Raccoon	North America	United States of America		Human-mediated	International (shared border)	By land/ water (presumed)	Suspected long-distance incursion from New York, USA into Hamilton, Ontario, Canada by stowing away on truck or ship; picked up by animal control along with 2 dogs; escaped cage and fought with dog; resulted in outbreak (>400 animals)	No	PEP, mass vaccination, ORV, enhanced surveillance (increased testing of sick animals), increased public awareness	Stevenson et al., 2016 (132); Trewby et al., 2017 (133); Lobo et al., 2018 (144); Gilbert & Chipman, 2020 (145); Nadin-Davis et al., 2020 (135)	Outbreak	Yes

Continent	Incursion location	Incursion date	Species	Origin continent	Location origin	Time between incursion & symptoms	Type of incursion	Borders crossed	Mode of travel	Incursion details	Phylogenetic analysis	Public health response	Local transmission	Unusual cross-species transmission	Reference(s)
North America	Canada	2015	Raccoon	North America	United States of America		Natural	International (shared border)	By land	Suspected incursion from New York, USA into Mohawk Nation, Akwesasne, Quebec, Canada indicated by phylogenetic analysis	Yes		Birhane et al., 2017 (146); Trewby et al., 2017 (133); Nadin-Davis et al., 2020 (135)	No local transmission	No
North America	Canada	2015	Raccoon	North America	United States of America		Natural	International (shared border)	By land	Suspected incursion from Maine, USA into New Brunswick, Canada (although phylogenetic analysis indicates earlier occurrence)	Yes		Trewby et al., 2017 (133)	No local transmission	No
North America	United States of America	Mar-16	Raccoon	North America	United States of America		Human-mediated	In-country	By land	Suspected human-mediated incursion from Connecticut into Hicksville, Nassau County, Long Island, New York indicated by phylogenetic analysis	Yes	Enhanced surveillance, increased public awareness	Brunt et al., 2020 (147)	No local transmission	No
North America	United States of America	Dec-16	Cat	North America	United States of America		Human-mediated	In-country	By air/land (presumed)	Owned, unvaccinated; imported from Ames, Iowa to Johnsonville, New York for vacation; attacked 1 dog, 3 humans; suspected infection by skunk indicated by phylogenetic analysis	Yes		Brunt et al., 2021 (148)	No local transmission	No
North America	United States of America	Dec-16	Otter	North America	United States of America		Natural	In-country	By water	Suspected incursion from Connecticut into Sound Beach, Suffolk County, New York indicated by phylogenetic analysis	Yes		Brunt et al., 2020 (147)	No local transmission	No

Continent	Incursion location	Incursion date	Species	Origin continent	Location origin	Time between incursion & symptoms	Type of incursion	Borders crossed	Mode of travel	Incursion details	Phylogenetic analysis	Public health response	Local transmission	Unusual cross-species transmission	Reference(s)
North America	United States of America	Feb-17	Cat	North America	United States of America	5 months	Human-mediated	In-country	By air/land (presumed)	Owned (newly-adopted), unvaccinated (for rabies), adult female with 3 kittens; imported from North Carolina to Arkansas along with >10 other pets (cats, dogs) then travelled to Summit County, Ohio and gave birth; surrendered to Humane Society of Summit County; vaccinated but not for rabies (according to facility guidelines, rabies vaccination only administered at time of spay/neuter); suspected infection by raccoon in North Carolina indicated by phylogenetic analysis	Yes	PEP, vaccination of exposed animals (recommended), 6-month quarantine of exposed animals (cats)	Singh et al., 2018 (60)	No local transmission	No
North America	United States of America	Nov-17	Cat	North America	United States of America			In-country	By land (presumed)	Owned, unvaccinated; imported from Westchester County to Long Island, New York; bit veterinary staff; suspected infection by raccoon indicated by phylogenetic analysis	Yes		Brunt et al., 2020 (147)	No local transmission	No
North America	United States of America	Dec-17	Dog	Africa	Egypt	1 day	Human-mediated	Intercontinental	By air	Owned, 6-month-old chihuahua; imported from with 3 other dogs by animal rescue organization to JFK airport, New York then Connecticut despite injuries; suspected falsified rabies vaccination document; bit 1 human (flight parent) before boarding plane	No	Contact tracing, PEP, booster vaccination of exposed animals (dogs), quarantine of exposed animals (dogs), monitoring	Blanton et al., 2009 (149); Hercules et al., 2018 (138); Chevalier & Havas, 2019 (150); Latzer et al., 2022 (143)	No local transmission	No

Continent	Incursion location	Incursion date	Species	Origin continent	Location origin	Time between incursion & symptoms	Type of incursion	Borders crossed	Mode of travel	Incursion details	Phylogenetic analysis	Public health response	Local transmission	Unusual cross-species transmission	Reference(s)
North America	United States of America	Jan-19	Dog	Africa	Egypt (via Canada)	1 month	Human-mediated	Intercontinental, international (shared border)	By air, land	Owned, recently-fostered 2-year-old; imported to Port Huron to Toronto, Canada with >20 other dogs; brought by car through Port Huron, Michigan to Kansas City; fostered with >10 animals (dogs, cats); bit 1 human (veterinary technician) during examination; had rabies vaccination certificate but serologic testing showed lack of vaccination in some dogs, indicating vaccination failure or falsification of vaccination certificate	No	PEP, suspension of dogs entering USA from Egypt, vaccination of exposed animals (booster) and 45-day monitoring, 6-month quarantine of exposed animals (unvaccinated dogs), quarantine of imported animals (dogs) and serologic monitoring	Raybern et al, 2019 (151); Latzer et al., 2022 (143)	No local transmission	No
North America	United States of America	May-21	Anteater	North America	United States of America	2 months	Human-mediated	In-country	By air/land (presumed)	Zoo-owned; imported from Virginia zoo to Tennessee Zoo, Washington County; suspected infection by raccoon indicated by phylogenetic analysis	Yes	Contact tracing, PEP, vaccination of exposed animal (tamandua) that was presumed unvaccinated due to missing vaccination records), quarantine of exposed animal (tamandua)	Grome et al, 2022 (152)	No local transmission	No
North America	United States of America	Jun-21	Dog	Asia	Azerbaijan	3 days	Human-mediated	Intercontinental	By air, other	Owned, vaccinated 5-month-old; imported with >30 other animals (dogs, cat) by animal rescue organization from Baku, Azerbaijan to Chicago O'Hare airport, Illinois, USA; relocated to Pennsylvania; serologic testing showed insufficient levels despite confirmed vaccination in Egypt, indicating vaccination failure due to underdosing	No	Contact tracing, PEP, (booster) vaccination of exposed animals (dogs, cat), serologic monitoring and 45-day quarantine of imported animals (dogs), suspension of dog importations from DMRVV high-risk countries	Williams & Pieracci, 2021 (153); Whitehill et al., 2022 (154)	No local transmission	No



Continent	Incursion location	Incursion date	Species	Origin continent	Location origin	Time between incursion & symptoms	Type of incursion	Borders crossed	Mode of travel	Incursion details	Phylogenetic analysis	Public health response	Local transmission	Unusual cross-species transmission	Reference(s)
North America	Canada	Jul-21	Dog	Asia	Iran (via Germany)	11 days	Human-mediated	Intercontinental	By air	Owned (newly adopted), presumed vaccinated, three-month-old puppy; imported from Tehran, Iran by animal rescue organization to Ontario, Canada through Frankfurt, Germany; was not revaccinated upon arrival despite vaccination policy for young dogs	No	Contact tracing, PEP, (booster) vaccination of exposed animals (dog), 3-month quarantine of exposed animal (dog) due to delayed identification	Rebellato et al., 2022 (155)	No local transmission	No
South America	Brazil	2006	Dog	South America	Bolivia		Natural	International (shared border)	By land	Incursion from Germán Busch Province into Corumbá, Mato Grosso do Sul, Brazil; attributed to high numbers of free-roaming dogs	No	Mass dog vaccination	Galhardo et al., 2019 (156)	No local transmission	No
South America	Peru	2015	Dog	South America	Peru		Natural	In-country	By land	Incursion from Puno into Arequipa; attributed to low vaccination rate among free-roaming dogs, commonly found foraging in water channels throughout city that collect garbage for foraging during dry season; resulted in outbreak	No	Mass dog vaccination, culling (stray dogs)	Castillo-Neyra et al., 2017 (157); Castillo-Neyra et al., 2017 (158); Raynor et al., 2020 (159)	Outbreak	No
South America	Brazil	2015	Dog	South America	Bolivia		Natural	International (shared border)	By land	Incursion into Maranhão, Brazil; further spread led to outbreak in Mato Grosso do Sul	No		Benavides et al., 2019 (160)	Outbreak	No