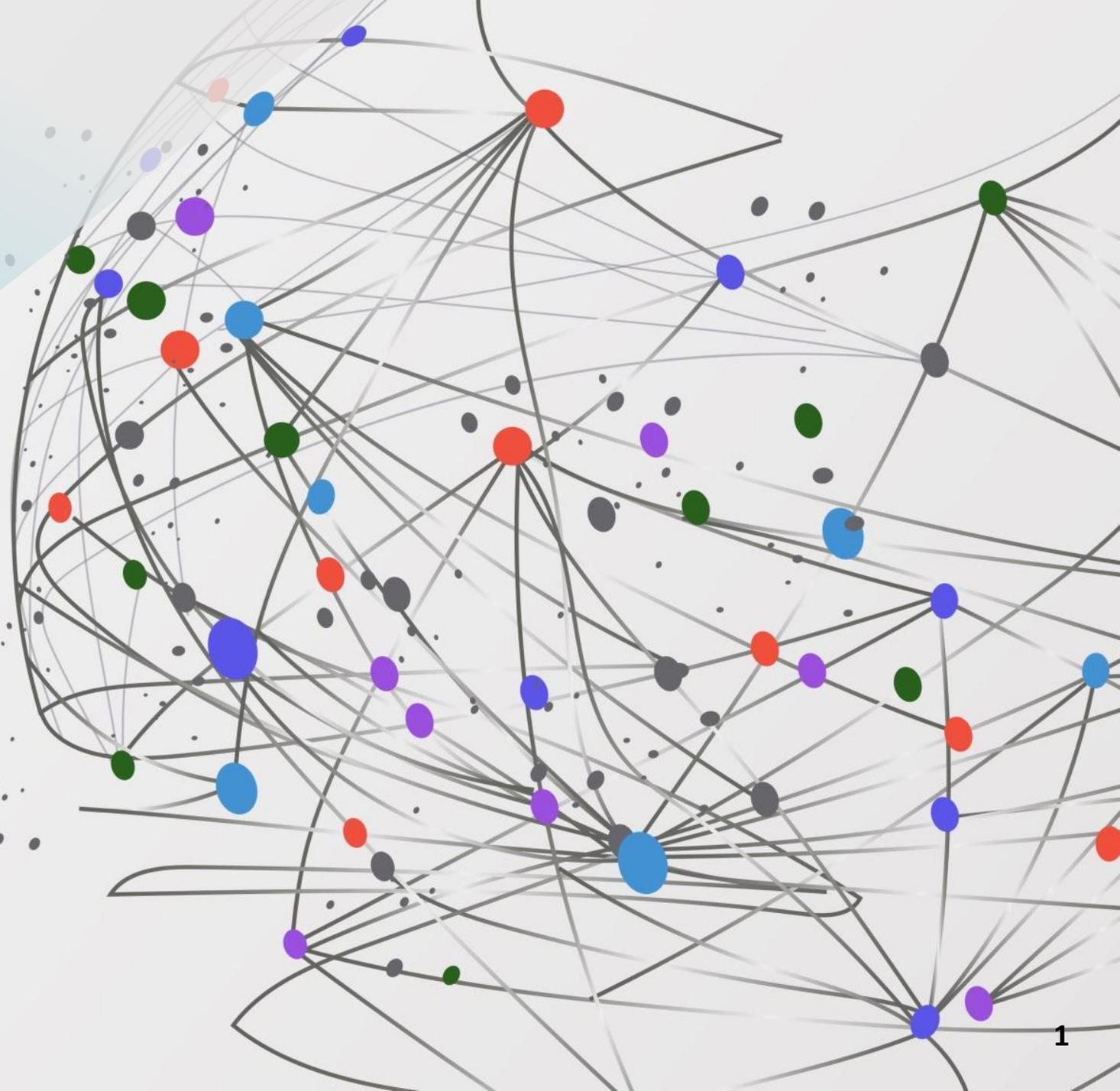




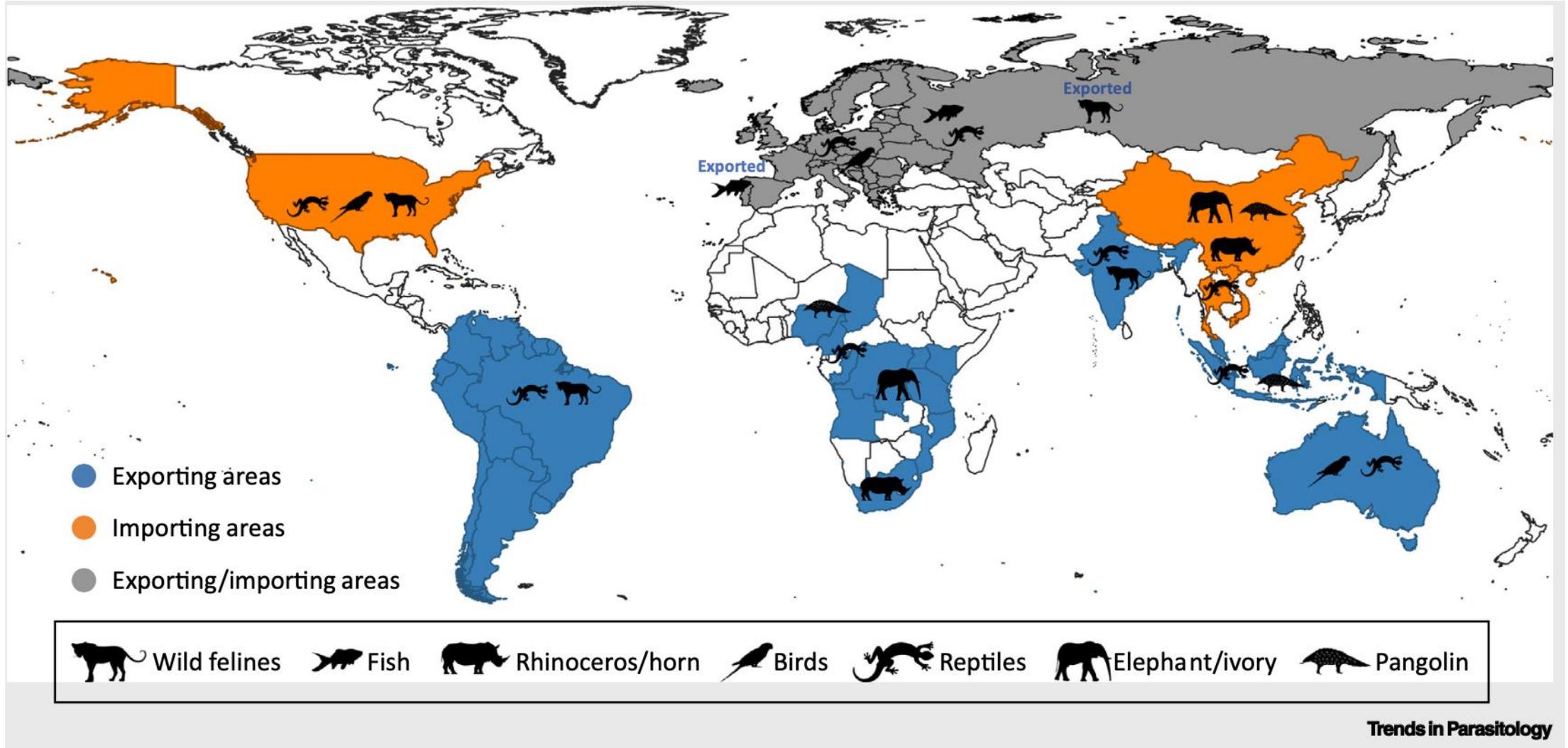
Interface identification for disease risk analysis

**Anuwat Wiratsudakul
Sarin Suwanpakdee**

*The Monitoring and Surveillance Center for Zoonotic
Diseases in Wildlife and Exotic Animals (MoZWE),
Faculty of Veterinary Science, Mahidol University*



The Main Source and Destination Areas of Endangered Wildlife Species Involved in the Illegal Trade Worldwide



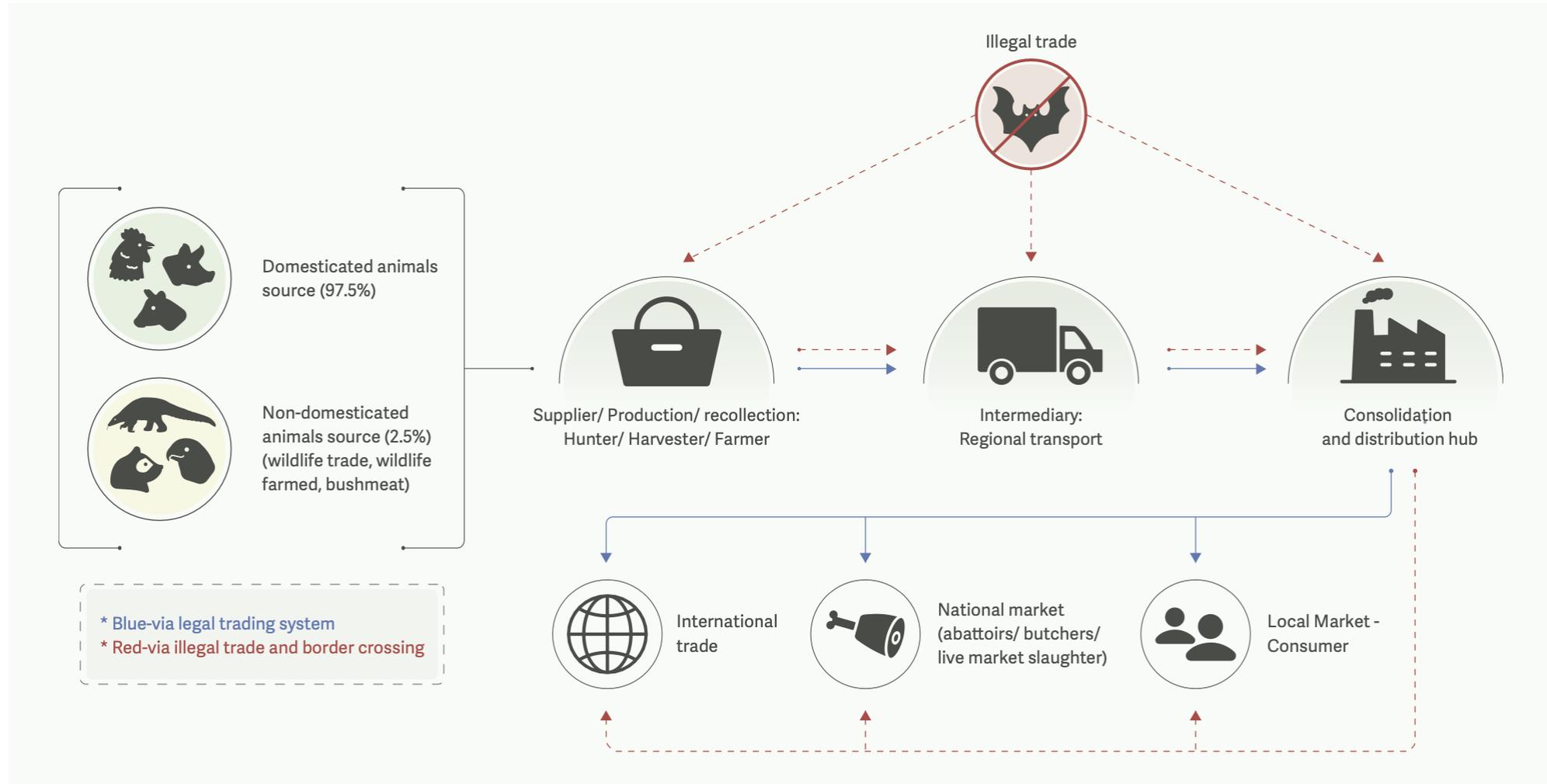
Pathogens of Public Health Concern Reported in Wildlife Illegally Traded Worldwide

Pathogen	Wildlife involved	Wildlife products	Trade type	Public health issues
Viruses				
Simian foamy virus (retrovirus)	Non-human primates	Bushmeat	International	Increase in pathogenicity following cross-species transmission
Cytomegalovirus (herpesvirus)	Non-human primates	Bushmeat	International	Concern for immunocompromised people
Lymphocryptovirus (herpesvirus)	Non-human primates	Bushmeat	International	B-cell tumors in immunocompromised individuals
Bacteria				
<i>Escherichia coli</i>	Birds, duiker	Live animals, bushmeat	National, international	Urinary-tract infection, meningitis, septicemia
<i>Klebsiella pneumoniae</i>	Birds	Live animals	National	Pneumonia, urinary-tract infection, septicemia
<i>Salmonella enterica</i> serovar Typhimurium	Birds	Live animals	National	Gastrointestinal infection
<i>Listeria monocytogenes</i>	Pangolin, red hog	Bushmeat	International	Meningitis, septicemia, and abortion in immunocompromised people
<i>Staphylococcus aureus</i>	Pangolin, duiker, red hog, fish	Smoked fish, bushmeat	International	Osteomyelitis, endocarditis, pneumonia, bacteremia, toxic shock syndrome
Parasites				
<i>Baylisascaris procyonis</i> (nematode)	Raccoons	Live animals	International	Neurological signs, visceral larva migrans
<i>Toxocara</i> sp. (nematode)	Raccoons	Live animals	National, international	Neurological signs, visceral larva migrans
<i>Trichinella</i> spp. (nematode)	Black bear, grizzly bear	Meat products	International	Intestinal, muscle, and neurological clinical signs
<i>Cryptosporidium</i> spp. (protozoan)	Non-human primates	Live animals	National	Intestinal clinical signs
<i>Hyalomma aegyptium</i> (tick)	Turtles	Live animals	International	Potential vector of zoonoses (e.g., <i>Borrelia turcica</i> ; Crimean–Congo hemorrhagic fever virus)

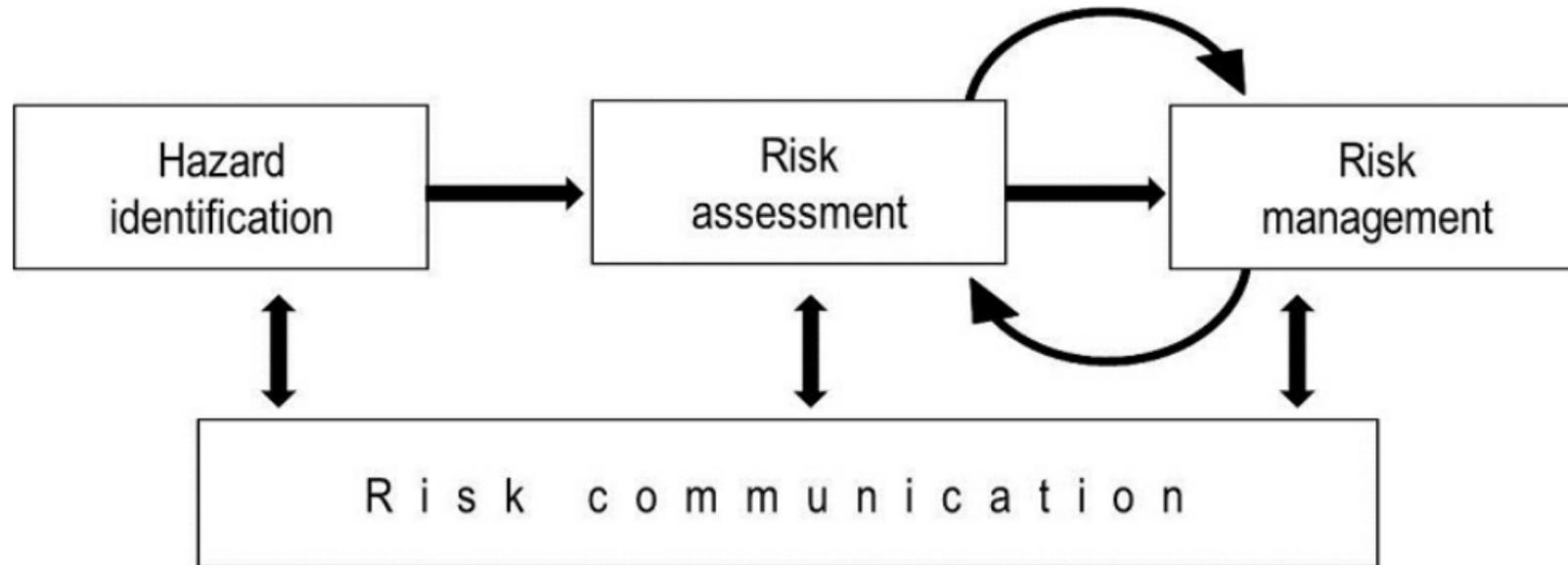
Disease risk analysis along wildlife supply chain



Simplified meat trade chain of domesticated and non-domesticated animals



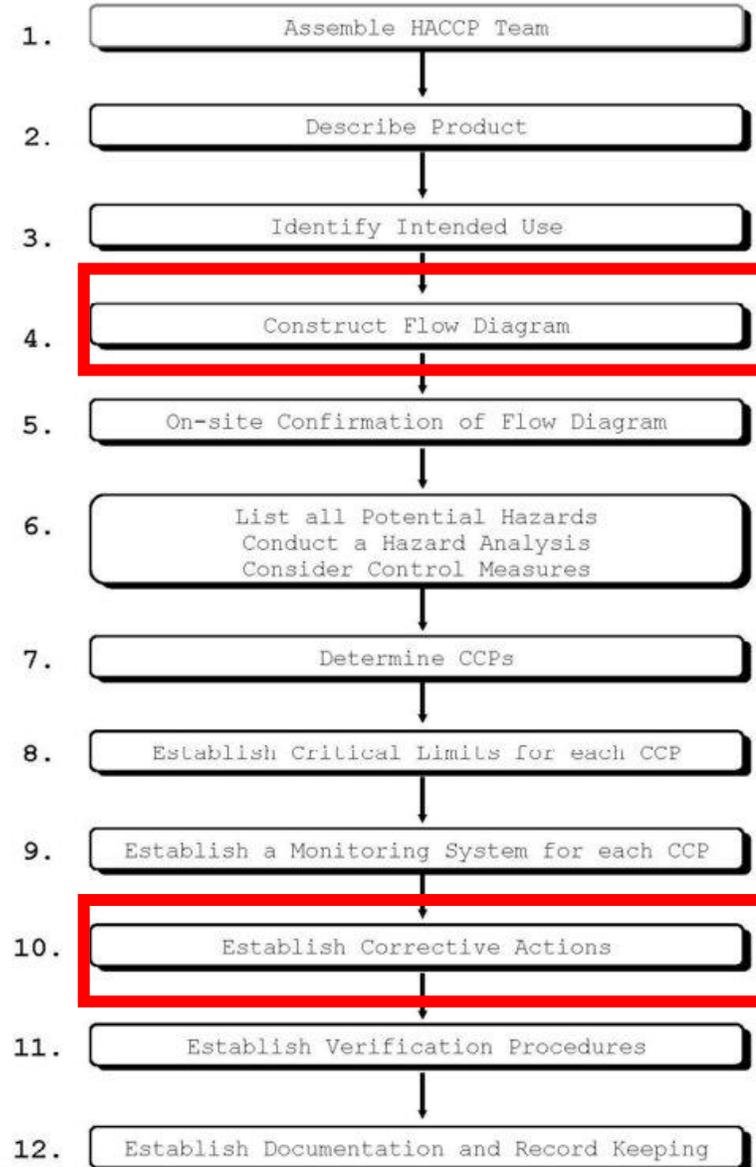
Disease risk analysis



Hazard identification involves identifying the pathogenic agents that could potentially produce adverse consequences associated with the importation of a commodity.

System thinking for zoonotic diseases in wildlife supply chain

LOGIC SEQUENCE FOR APPLICATION OF HACCP



Hazard analysis and critical control points (HACCP)

A system that identifies, evaluates and controls hazards that are significant for food safety (Pfeiffer et al., 2021).

You are here!

Critical control points are located at any step where hazards can be either prevented, eliminated, or reduced to acceptable levels.

Case study I

Wild Meat Handling Process from the Hunter to the Final Consumer

Zoonotic disease and food borne illness



Hunter Carrying a Freshly Killed Blue Duiker
(Photo credit: Nathalie van Vliet)

Vliet et al., 2022

Case study I Wild Meat Handling Process from the Hunter to the Final Consumer



Carcasses After Smoking



Smoked Carcasses Butchered at Market
(Photo credit: Jonas Nyumu)

Case study I Wild Meat Handling Process from the Hunter to the Final Consumer

Construct flow diagram

Risk for zoonotic disease and food borne illness



Hunters



Village



Market



Consumer in towns



Household

Vliet et al., 2022

Case study I Wild Meat Handling Process from the Hunter to the Final Consumer

Construct flow diagram

Risk to zoonotic disease and food borne illness



Hunters

- Direct contact with carcass
- The butchering of a fresh carcass
- No disease prevention and use of Personal Protective Equipment (PPE)
- Risk for zoonotic diseases such as external and internal parasites, *Escherichia coli.*, etc., for hunters



Village



Household

- Unsanitation transportation from hunting to market
- Removing decomposed meat
- Using mosquito nets to avoid flies
- Risk for food-borne diseases



Market

- Selling wild smoked and fresh meat
- Covering the meat with leave and dry area, or freezing the meat with a generator
- Using mosquito nets to avoid flies
- Mostly not washing a hand

- Preserving wild meat by smoking, covering with leave and dry areas, and removing decomposed meat
- Using water from a stream

- Most of them are worried about food safety
- Having criteria to deselect a decomposed meat
- Feeding a remaining food to pets
- Using water from a stream

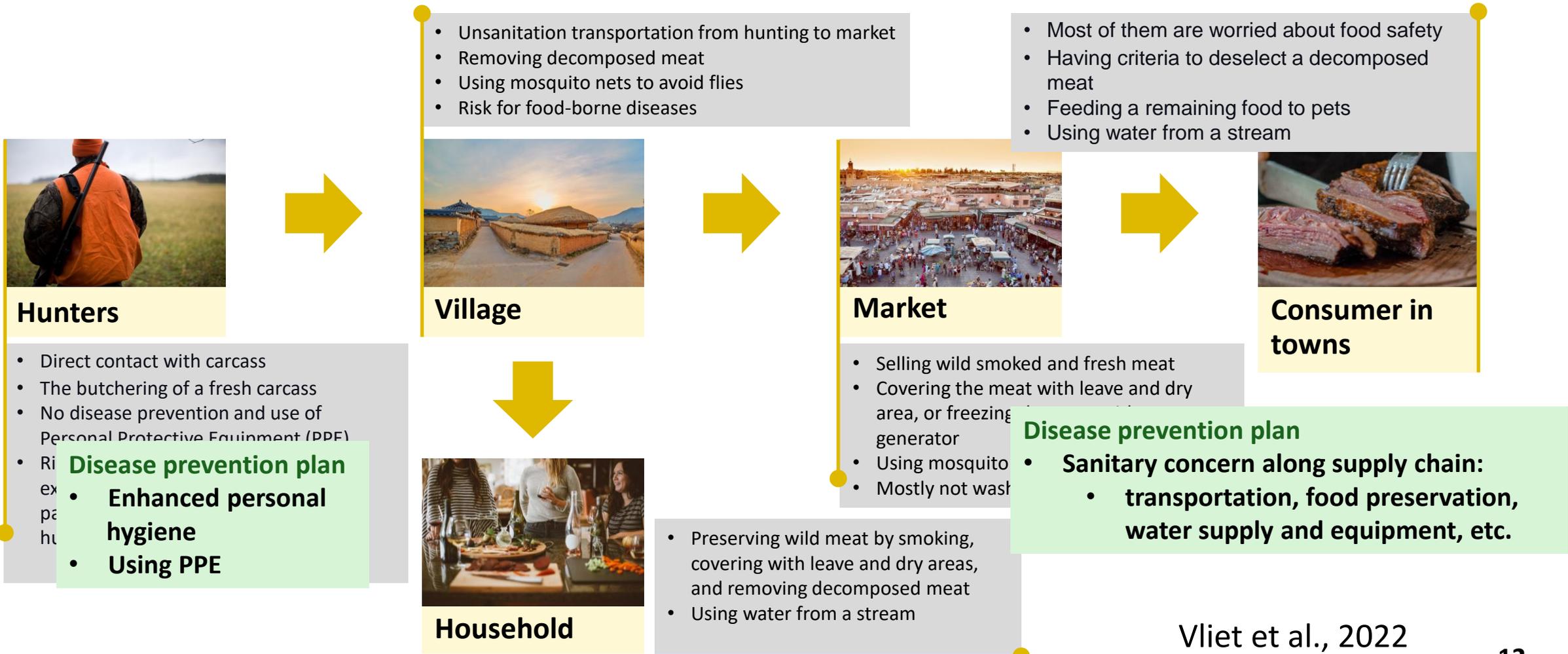


Consumer in towns

Vliet et al., 2022

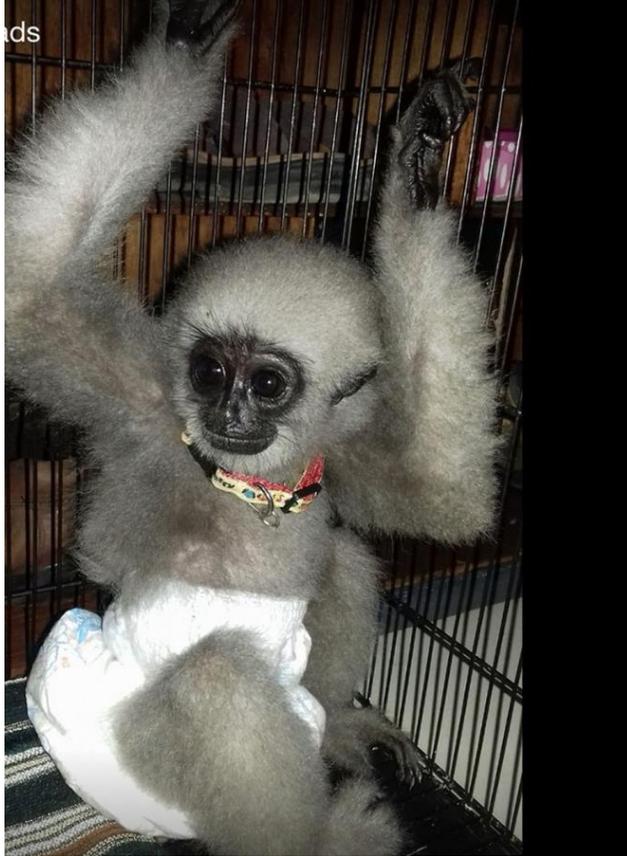
Case study I Wild Meat Handling Process from the Hunter to the Final Consumer

Establish collective actions



Case study II

Pet primates: Illegal wildlife trade



Infant gibbon offered for sale on Instagram in Indonesia



A juvenile female orangutan chained and kept illegally as a pet in West Kalimantan, Indonesia. Photo: © Gunung Palung Orangutan Conservation Program

A juvenile female orangutan chained and kept illegally as a pet in West Kalimantan, Indonesia. Photo: © Gunung Palung Orangutan Conservation Program with an example of an embedded caption

Pet primates: Illegal wildlife trade

- Primates can be kept as pets because they are viewed as cute and ‘funny’ and often behave in familiar ways that are similar to our own behavior.
- Pet can be traded from wildlife trafficker and incidentally, when local hunters kill females with infants that are then kept as pets or sold.
- To breed in captive colonies
- International demand is driven by greater access to wealth, advertising on the internet and commercialization in films and videos.

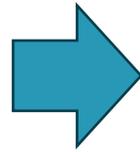
Norconk et al., 2019

Case study II Pet primates: Illegal wildlife trade

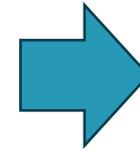
Construct flow diagram



Hunters



Intermediary: Regional transport



Distribution hub



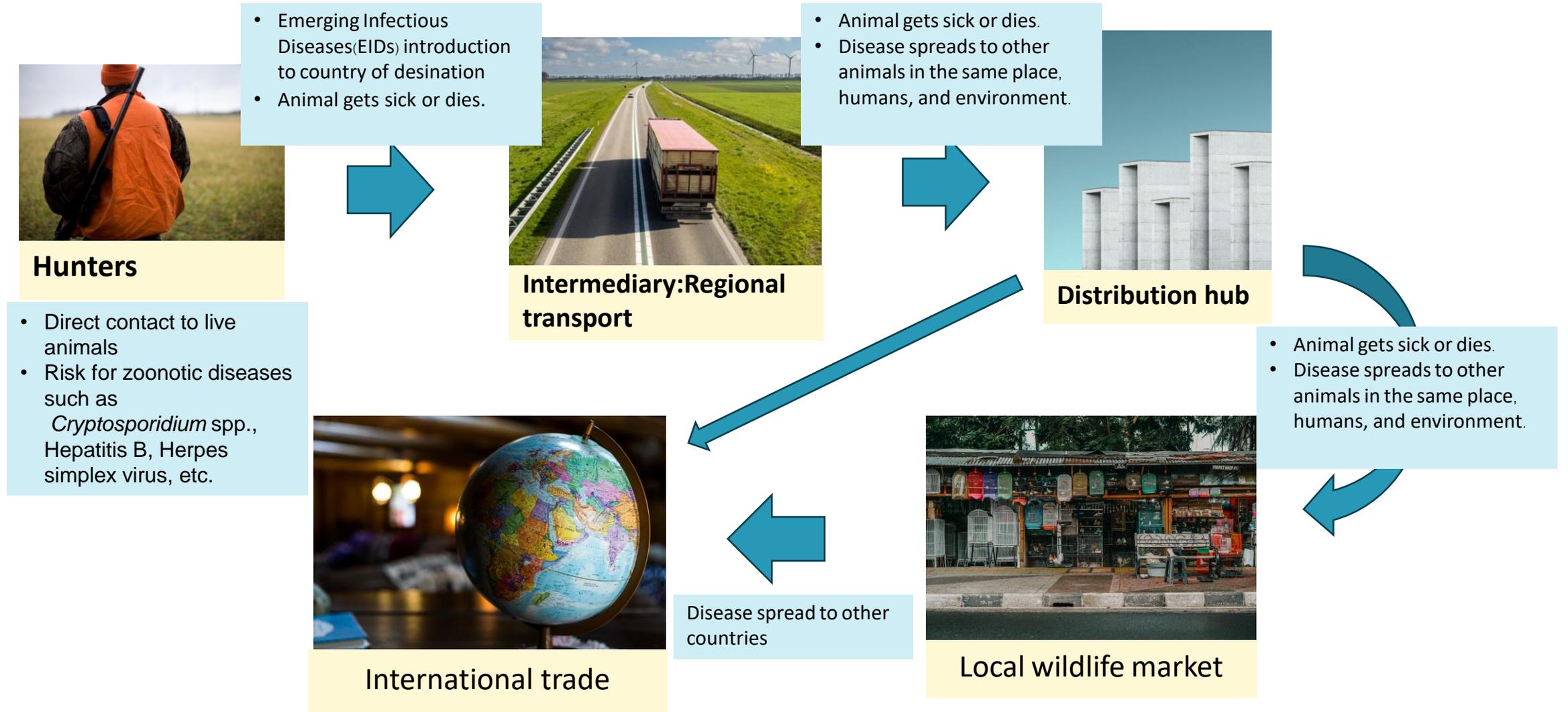
Local wildlife market



International trade

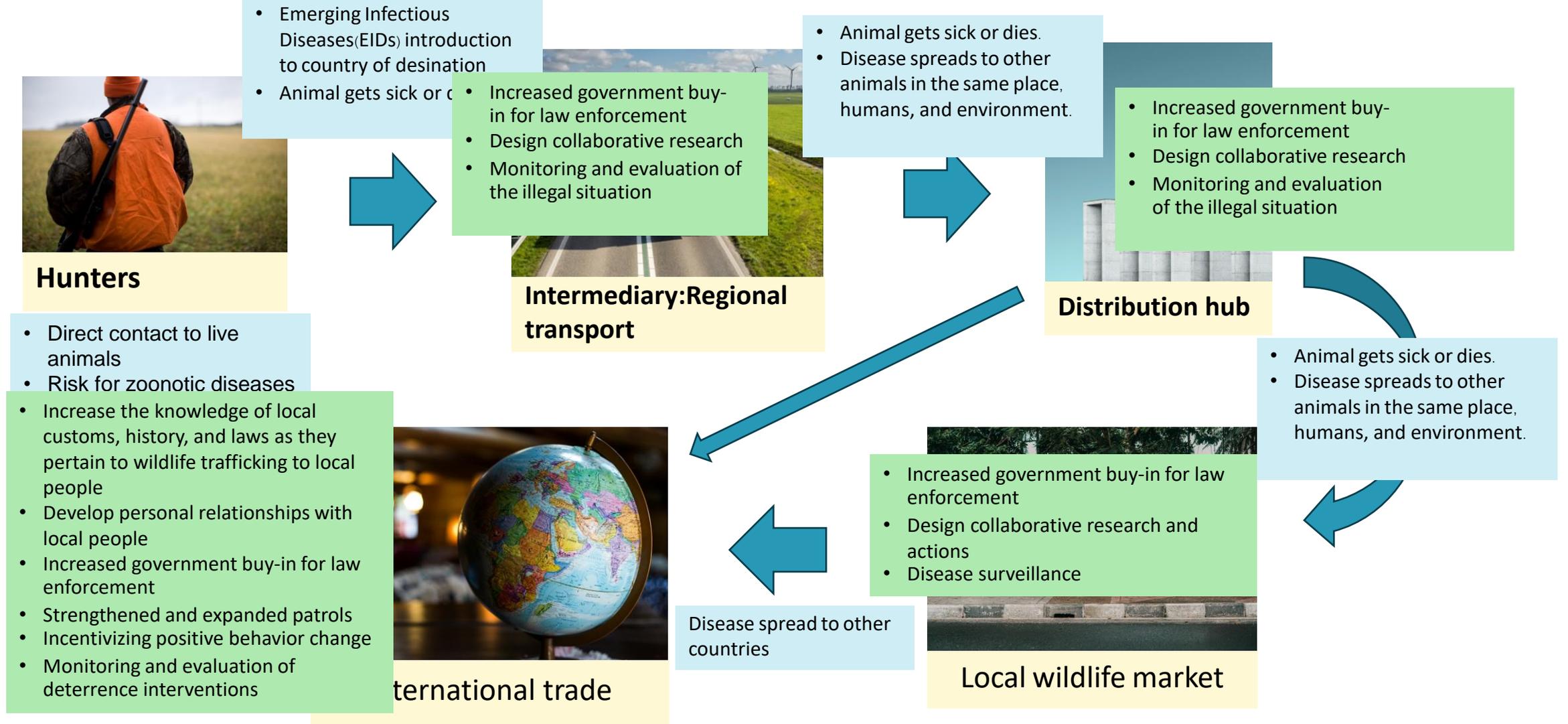
Case study II Pet primates: Illegal wildlife trade

Construct flow diagram



Case study II Pet primates: Illegal wildlife trade

Establish collective actions



Disease information: WAHIS



World Organisation
for Animal Health
Founded as OIE

WAHIS

Analytics ▾

Reports ▾

WOAH ↗

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HOME >> ANIMAL DISEASE EVENTS

Events management

Filters

See on the map

<input type="checkbox"/>	Country	Report number	Disease	Genotype/ Serotype/ Subtype	Reason	Start date	Report date	
<input type="checkbox"/>	United Kingdom	FUR_8	High pathogenicity avian influenza viruses (poultry) (Inf. with)	H5N1	Recurrence of an eradicated disease	2023/10/20	2023/12/15	
<input type="checkbox"/>	United Kingdom	FUR_9	Influenza A viruses of high pathogenicity (Inf. with) (non-poultry including wild birds) (2017-)	H5N5	Recurrence of an eradicated strain	2023/09/25	2023/12/15	
<input type="checkbox"/>	United Kingdom	FUR_74	Contagious equine metritis		Recurrence of an eradicated disease	2022/06/27	2023/12/15	
<input type="checkbox"/>	Austria	FUR_6	Influenza A viruses of high pathogenicity (Inf. with) (non-poultry including wild birds) (2017-)	H5N1	Recurrence of an eradicated disease	2023/10/20	2023/12/15	

<https://wahis.woah.org/#/event-management>

Disease information: ProMED



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18 Dec 2023 [Varicella update \(07\): Jordan, increasing incidence](#)

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Published Date: 2023-12-18 08:58:39 +07
Subject: PRO/AH/EDR> Dengue/DHF update (40): Africa (Nigeria)
Archive Number: 20231218.8713779

DENGUE/DHF UPDATE (40): AFRICA (NIGERIA)

A ProMED-mail post
<http://www.promedmail.org>
ProMED-mail is a program of the
International Society for Infectious Diseases
<http://www.isid.org>

<https://promedmail.org/>

Disease information: WHISPers

WHISPers Wildlife Health Information Sharing Partnership
Event Reporting System

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Search

Event ID

Event Type

Date Range Jul 31, 2023 – Aug 28, 2023

Diagnosis Type

Event Diagnosis

Species

State (or equivalent)

County (or equivalent)

Number Affected

Record Status

Export Search Results

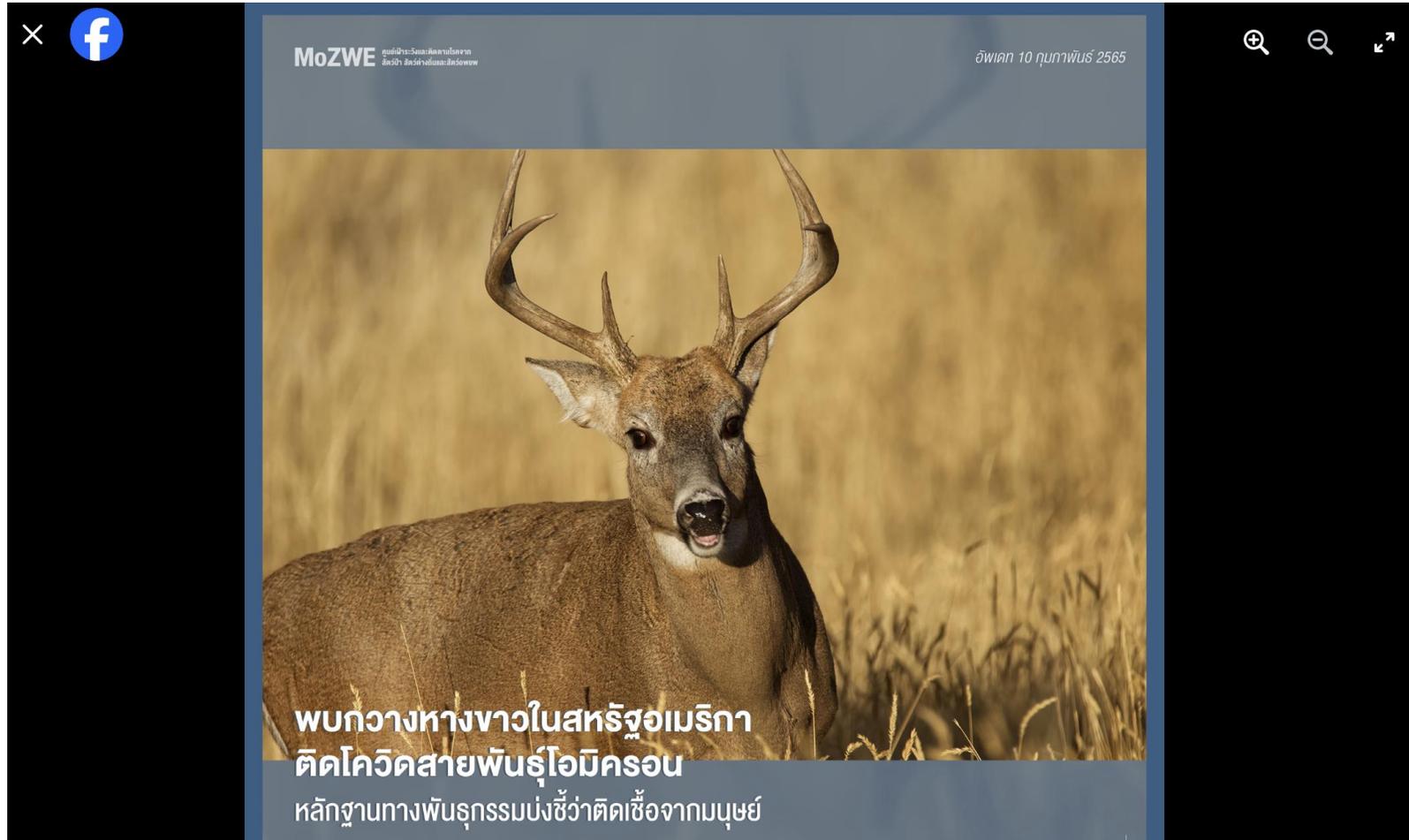
Popular Searches

Search Results Map ^

Search Results

Event ID	Event Type	Number Affected	Event Start Date ↓	Event End Date	Location	Species	Event Diagnosis
203522	Mortality/Morbidity	1	8/27/23	8/27/23	Smith County, Kansas, United States	House Sparrow	Pending

Disease information: MoZWE facebook



ศูนย์เฝ้าระวังและติดตามโรคจากสัตว์ป่า ... สัตว์ต่างถิ่นและสัตว์อพยพ (MoZWE) · 10 กุมภาพันธ์ 2022 · 🌐

🦌 พบกวางหางขาวในสหรัฐอเมริกาติดโควิดสายพันธุ์โอมิครอน 🦌

นักวิทยาศาสตร์ในสหรัฐอเมริกาเผยแพร่งานวิจัยผ่าน bioRxiv เกี่ยวกับการพบเชื้อไวรัส SARS-CoV-2 สายพันธุ์โอมิครอน (Omicron variant) จากกวางหางขาวในนิวยอร์ก สหรัฐอเมริกา ซึ่งเป็นการพบการติดเชื้อสายพันธุ์นี้ครั้งแรกในสัตว์ป่า

◆ การเก็บตัวอย่าง

นักวิจัยทำการเก็บตัวอย่างจากฝูงกวางที่อาศัยในเกาะสแตเทน (Staten island) นครนิวยอร์ก รัฐนิวยอร์ก สหรัฐอเมริกา (New York city, New York, U.S.) ตั้งแต่วันที่ 12 ธันวาคม 2021 ถึงวันที่ 31... ดูเพิ่มเติม

👍❤️ 12 1 ➦

👍 ถูกใจ 💬 แสดงความคิดเห็น ✎ แคร่ 🌐

👤 เขียนความคิดเห็น...

🗨️ 😊 📷 🧠 🗑️ ➦

https://www.facebook.com/MoZWE/photos?locale=th_TH

Exercise

Please identify and describe the risk of disease occurrence along the wildlife supply chain in the following example.

Step	Potential Hazard(s)	Justification	Hazard to be addressed in plan? Y/N	Control Measure(s)	Responsibility
Importation	Enteric pathogens: e.g., <i>Salmonella enterica</i> serova Typhimurium	Enteric pathogens have been associated with a high frequency of gastrointestinal infection in human cases from live birds.	Y	Quarantine, screening test, and treatment	Rehabilitation Center of Wild Animals

Any questions?