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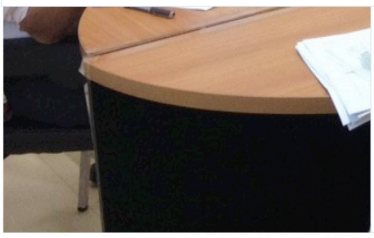
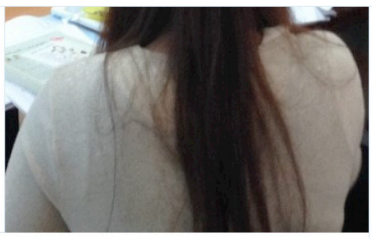
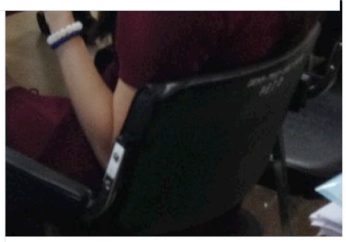
GUIDANCE FOR INCLUSION OF EMERGING INFECTIOUS DISEASES IN HEALTH AND ENVIRONMENTAL IMPACT ASSESSMENTS







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Executive Summary

Recent outbreaks of emerging infectious diseases (EIDs)—including the 2014-2016 Ebola virus crisis in West Africa—have had major economic impacts for industries operating in the affected areas in the form of trade, travel, and supply chain disruptions. In some cases they have completely shut down operations. EIDs have cost the global economy billions of dollars over recent decades, and the rate of disease emergence appears to be increasing, with the majority of recent EIDs originating from animals ("zoonoses"), primarily wildlife. The highest risk is in "hotspots" that have rich biodiversity, poor public health infrastructure, and ecological disruptions to landscapes. While EIDs seem to appear without warning, and public health measures to address EIDs have primarily been reactive, it is possible to anticipate risks and take preventative steps against vulnerabilities and potential impacts to business operations.

This Planning Tool and its associated Audit Guidelines are intended as resources to aid industries and funders in identifying potential project vulnerabilities to EIDs and proactively taking steps to be more resilient to the risk of many different types of communicable disease events. These documents are intended to supplement (not replace) existing guidelines (e.g. IFC, World Bank, and internal), as exposure to zoonotic pathogens requires a more holistic analysis than normally taken in environment and social impact assessments or health impact assessments. Importantly, many of the measures that can be used to prevent emergence and spread of zoonotic diseases may also reduce the burden of vector-borne, water-borne, and food-borne illness, and other endemic diseases (e.g. TB, Malaria, Dengue, HIV & other STIs, etc.), in addition to promoting environmental safeguards.

The Planning Tool provides background on EIDs, including risk factors for their emergence and their transmission routes. A screening checklist is provided to determine whether EID risk should be considered in an impact assessment, health, environment, or social. The Tool highlights additional baseline information not routinely collected during environmental and social, and health impact assessments. In addition, it details how such information can enhance the existing planning process, and provides examples and templates for known zoonotic disease risk for specific locations (most based on publically available information). Most tangibly, specific transmission mitigation opportunities are highlighted with their indicators, surveillance methods, and sectoral responsibilities noted.

While individual pathogens and transmission factors may be complex, the Planning Tool and Audit Checklist focus on exposure and transmission pathways, and broad measures that can help identify and reduce transmission risk. Many of the assessment topics will be familiar to planning managers, but the tools provide additional considerations that can help assess EID vulnerabilities.

While the guidelines emphasize minimizing contact opportunities with animals and vectors (mosquitos, ticks, etc.), it is important to note that animal extermination/culling measures around a facility are rarely appropriate as the associated loss of biodiversity may have negative health outcomes. Thus, the aspects in the Planning and Audit Tools promote measures based on the best available science, and are designed to balance health and environmental considerations, encouraging involvement of wildlife authorities/environmental managers in addition to health experts on decision making for pest control.

The Planning Tool and Audit Guidelines provide science-based guidance (with key technical sources provided) compiled by a team of infectious disease, biodiversity and international development experts under the USAID Emerging Pandemic Threats program.

Industrial Development Projects and Emerging Infectious Diseases

The 2014 Ebola Outbreak in West Africa brought to light the devastating effects of emerging infectious diseases on the local population as well as the severe disruption to economies and in many cases, large-scale industrial activities. Although Ebola had never been documented in that part of West Africa, the conditions were present and not fully appreciated not only for the presence of Ebola, but also for its widespread transmission. Ebola is not the only emerging infectious disease disrupting work flows. Outbreaks of Marburg hemorrhagic fever, caused by a related virus and harbored by select bat species, resulted in the shutdown of gold and lead mining sites as well as caves used for ecotourism. The majority of human infectious pathogens have originated from animal transmission to humans ("zoonotic diseases"), and of these, the majority of emerging and re-emerging infectious diseases originate in wildlife. Three wild animal groups, which comprise approximately 70 percent of mammal species, are considered most likely to spread new infections to people: bats (Corona virus responsible for SARS and Marburg, Nipah and Rabies viruses), rodents (Lassa, hanta, and monkeypox viruses) and non-human primates (transmission of Ebola and origins of HIV). People contract these diseases by inhalation of aerosolized contaminated feces and urine, through direct contact via scratches, bites, and bodily fluids—such as blood and saliva—that can occur during hunting, butchering, and food preparation, and by ingesting contaminated food, water, or undercooked meat.

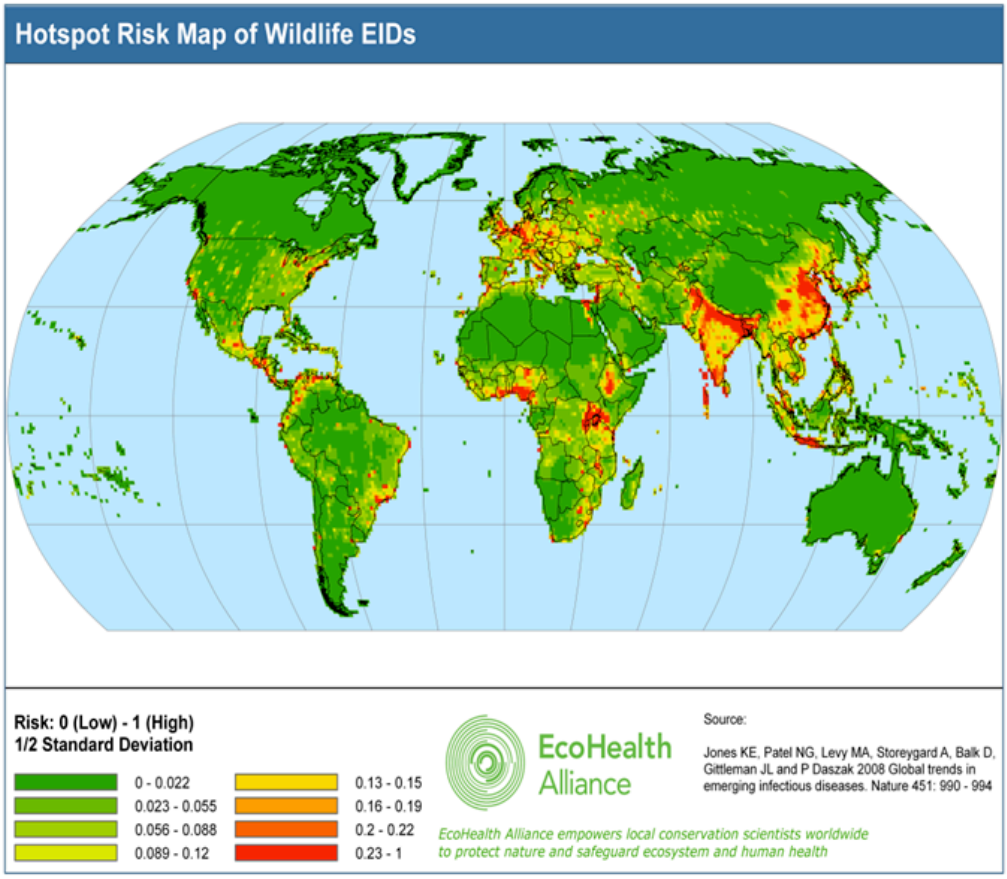


Figure 1: Hotspot Risk Map of Emerging Infectious Diseases from Wildlife

A study conducted by Jones et. al. (2008) analyzed the drivers for disease emergence and identified where emerging infectious diseases are likely to originate. These places are informally known as

disease "hot spots" (see Figure 1). The emergence of infectious diseases of zoonotic origin was associated with high wildlife biodiversity and human population density. While the "hot spot" map identifies locations in both developed and developing countries, the weaker health care, water, food, and waste management infrastructures of developing countries may not be able to identify or address existing health needs or ones that could be associated with emerging or re-emerging diseases of zoonotic origin. Industrial development in these types of areas can cause a population influx of job seekers and their families that further stresses the already taxed infrastructures. Stressed systems are more likely to break down, creating ideal conditions for increased communicable or infectious disease transmission.

Population growth in combination with industrial development can lead to changes in the distribution and abundance of wildlife and its associated pathogens. Especially in remote areas, people may interact with wildlife with which human contact was previously limited or non-existent, exposing them to novel pathogens for which they have no prior immunity. Increasing contact among people, domestic animals (e.g. livestock), and wildlife populations increases the likelihood of disease transmission among/between species. For example, wildlife may become a nuisance by taking advantage of new food sources and habitats created at construction camps, canteens, and villages. Animals raid crops in fields that border their habitat, invade labor camps and homes, become violent, or eat infected animals. Hunting pressure for bushmeat may increase.

Although we cannot predict exactly when emerging infectious disease outbreaks are going to occur, there are public health prevention, environmental, and social strategies that industry can employ to minimize risks associated with both emerging and known infectious diseases. This tool is designed for industries to proactively examine their proposed projects in "hot spot" areas in order to identify vulnerabilities to zoonotic pathogens and to develop strategies to minimize risks of emerging infectious diseases while minimizing exposure to food, waterborne diseases, and certain vector-borne infectious diseases.

Emerging Infectious Diseases and Impact Assessments

Addressing emerging infectious diseases is an environmental, health, and social issue, requiring a collaborative approach that bridges these fields. This document provides the steps to incorporate emerging infectious diseases of zoonotic origin into a health, social, or environmental impact assessment, and into a company's internal hazard or risk assessment process. Examining the issues that can lead to zoonotic pathogen exposure requires a more holistic analysis than normally taken because those issues are associated with a range of industrial activities including biodiversity/conservation management, facilities management (camp, canteen, water, and waste), worker health, and community health/corporate social responsibility. Other analyses would not normally be conducted in either an environmental, health, or social impact assessment, so this document provides guidance on the topics to consider, how analyses could be conducted, and what mitigation measures could be adopted.

While this document is not intended to provide definitive guidance on how to incorporate zoonotic diseases into impact assessments, it does aim to provide sufficient information and guidance for a practitioner to know what information needs to be gathered and analyzed to determine the possibility of exposure and guide risk mitigation. This document is part of a set of guidance documents and other tools that can be used by industry to assess and address their vulnerabilities to zoonotic diseases. The following figure illustrates where this planning tool falls in the industrial project cycle and the environmental, social, and health impact assessment cycle (see Figure below).

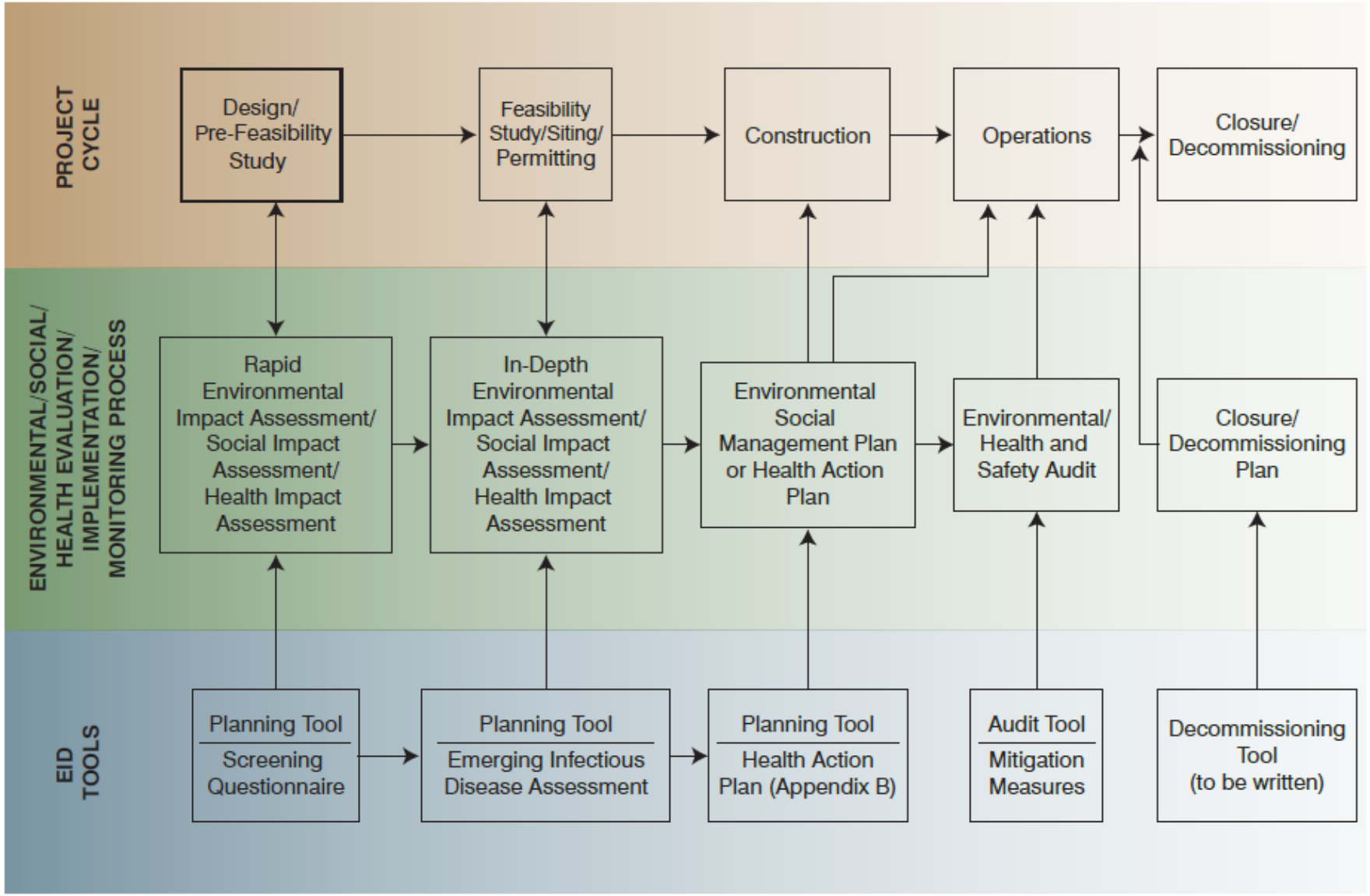


Figure 2: Planning Tool applications in project cycle

This document assumes that a practitioner has a basic knowledge of impact assessment processes.

Adding this type of analysis supplements the depth of an impact assessment and addresses portions of the following IFC Performance Standards:

- Performance Standard 1: Assessment and Management of Environmental and Social Risks and Impacts
- Performance Standard 2: Labor and Working Conditions
- Performance Standard 4: Community Health, Safety, and Security
- Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources

Screening

To determine whether emerging infectious diseases of zoonotic origin should be considered in an impact assessment, a basic understanding of the zoonotic disease exposure potential is essential. The following screening checklist seeks to identify whether a proposed/existing project is in an area with a potential for zoonotic disease exposure and to identify if there will be/are activities that might exacerbate the risk of transmission.

Screening Questions	Yes/No	Notes
1. Will the project be located in an area where there are wildlife species that could host zoonotic diseases? (See Appendix A) Is the site ecologically similar to areas where zoonotic diseases have emerged?		Hot spots with a higher risk of emerging infectious diseases are located throughout the world, but especially those places with increased land-use change, human population growth and areas with high biodiversity (see Figure 1)
2. Will the project be located in a previously undeveloped area or natural area? Will existing land use cover, change significantly so that wildlife habitat will be lost or significantly modified in or near the project site?		The likelihood of contact with wildlife, their fluids or excreta increases in areas being converted from natural habitats to developed areas.
3. Will the project require constructing new roads or rail or transmission line/pipeline corridors through relatively intact forest or otherwise natural habitats?		Roads and corridors increase the interaction of human and wildlife by opening up new areas for hunting, logging and agricultural colonization. Habitats are often modified and certain species are favored at the road interface. Roads are used to transport bushmeat, livestock and animals destined for the wildlife trade.
4. Will an onsite temporary or permanent camp be established?		Camps, canteens, and food/waste/water management facilities can attract pest/wildlife, increasing potential contact between people and wildlife and their excreta, increasing transmission risk.

Screening Questions	Yes/No	Notes
5. Will there be a fly-in/fly-out population? Will workers travel in and out of the project area with the potential to carry infectious diseases acquired in the project location to their home locations and introduce diseases from outside into the project area? Within the country? Internationally?		Exposed people could leave the facility without knowing that they are sick and expose others along transportation routes.
6. Will the infrastructure in surrounding communities be insufficient to accommodate any anticipated population expansion? Is this already a problem?		Insufficient potable water, sanitation, health care, and vector control can amplify any infectious disease that occurs locally.
7. Do the local communities have inadequate health care facilities to address local health care requirements? Are existing medical treatment and diagnostic services insufficient to manage an outbreak of infectious diseases known to be in the project location?		Inadequate or insufficient local health care facilities can mean that diseases in the local communities can be brought to the facility.
8. Will an international medical evacuation plan be required or available to transport and treat worker with potentially contagious infectious diseases?		International movement may facilitate international spread
9. Will a relatively large labor influx occur compared to the existing population?		New immigrants to an area may not have immunity to endemic diseases or may bring new diseases to an area. Project-induced labor and other in-migration can strain local health and other infrastructure systems. Poorly functioning water and waste management as well as health care systems can result in the amplification of infectious disease transmission.
10. Will the employees have to source their own food? (i.e., the company will not provide a food source).		The increase on food demand from the new facility on local area could exacerbate pressure on existing food sources, availability and pricing, and natural resources, increasing hunting pressure and the use of non-forest timber products, including expanding agriculture into new areas that may have been previously undisturbed. If a reliable protein source is not provided, employees may have to rely on food from hunting.
11. Will livestock be on-site or near the site? Will staff be allowed to have pets on-site?		Pathogens can be transmitted between wildlife and domestic animals. People can then acquire pathogens from domestic animals. Livestock introduced to new areas may bring diseases for wildlife and people.
12. Will there be on-site agricultural production? Will additional in-migration lead to agriculture expansion in adjacent areas?		Grain and fruit production attracts wildlife and pests. Food products can be contaminated from animal byproducts and/or direct contact with wildlife.

While no individual item(s) from the checklist necessarily implies that a project would be vulnerable to zoonotic diseases, a combination of factors could increase the potential for exposure to zoonotic or other communicable diseases. Therefore, if the answer to question 1 and any other question(s) is "yes", then it is worthwhile to further examine the potential of emerging infectious diseases for your project area.

Please keep in mind when going through the screening checklist that emergence events are rare, but when they occur there can be devastating consequences. The risk of potential exposure needs to be balanced with the other risks inherent in the proposed project. However, many of the steps highlighted can also reduce risk of endemic, food, water and vector-borne diseases, as well as manage environmental and social risks.

Scope

Since this assessment is intended to be incorporated into an existing or ongoing assessment, it is presumed that the geographic and temporal boundaries of any analysis have already been established as well as the potentially vulnerable populations. Unlike many standard environmental, social, or health impact assessments, both worker and local populations must be considered. Worker populations are considered in company risk or hazard assessments, but in this assessment they are considered on a continuum with local population as they may reside in the community (if on-site housing is not provided), or come into frequent contact with the community.

Additional Baseline Data to be Collected

Baseline environmental, social, and health data are collected to support the impact assessment process. To assess the potential for exposure to zoonotic pathogens, it is necessary to not only understand the characteristics and behaviors of wildlife species endemic to a project area, but to also take into account a local community's relationship to them. These data would supplement various components of the baseline data. The following table provides suggested topic areas where these data would supplement the baseline data collection and indicates whether that data is normally collected as part of an ESIA or HIA.

Data To Be Collected	**ESIA**	**HIA**
	Included Usually?	
Obtain or generate a species list of wildlife endemic to the area, including rodents.	Yes	No
Determine whether the most common wildlife species are known carriers of zoonotic pathogens, what their ecological behaviors are (e.g. roosting in caves) and what they typically eat.	No	Maybe
Have there been outbreaks of those diseases? Among people? Wildlife? Livestock? When? Are there any undiagnosed illnesses reported by health authorities or local clinics?	No	Maybe
Determine how the project will feed its personnel. Will the project provide food for all staff or only ex-patriate staff?	No	Maybe
Determine sources of protein for existing and increased population; if bushmeat is used as a source of protein, what species are hunted?	No	No
Determine what methods are used in harvesting, butchering, transporting, and preparing bushmeat.	No	No
Determine how local communities interact with rodents, bats, and non-human primates, and what potential exposure pathways exist between these animals and humans in the area.	No	No
What wildlife species are considered pests? What are the local methods to control these pests?	No	No

Data To Be Collected	ESIA	HIA
	Included Usually?	
Determine the capacity of the local community's infrastructure with respect to potable water supply, sanitation, and vector control.	No	Yes
Determine the capacity of the local community's infrastructure with respect to health care and veterinary services.	No	Yes/maybe
Assess potential sources of food for rapidly increasing population; including the extent and location of potentially arable land.	No	Yes
Current population of the project area	Yes	Yes
If possible, collect data from local governmental and non-governmental organizations regarding existing local wildlife diseases.	No	Maybe
Assess types of nearby wildlife habitat, its integrity, and the extent to which it is at risk of conversion, fragmentation and/or degradation due to project-induced population influx.	Yes	No

Please note that a general social baseline/livelihoods baseline is important to enable holistic understanding of local community and their potential to adapt to changes and social management plans (including management of health risks).

Assessing potential vulnerabilities to emerging infectious diseases

A project's potential vulnerability to emerging infectious diseases were identified in the screening checklist and illustrated below.

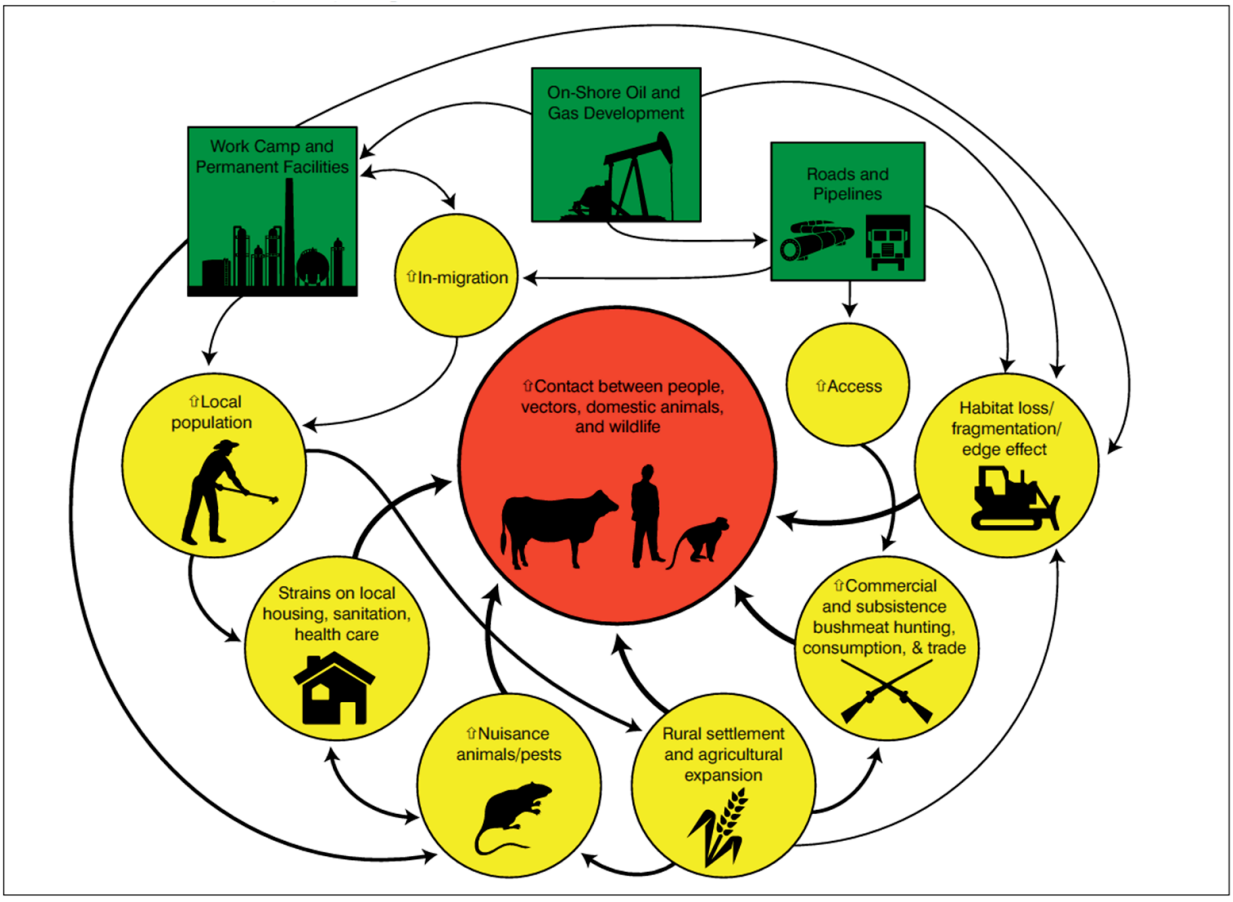


Figure 3: Cascading effects of on-shore oil development on increasing contact among people, domestic animals, vectors and wildlife.

To assess areas of vulnerability, this guidance's approach is to examine the components of projects that could increase or decrease vulnerability to EID exposure as a means of identifying where prevention measures could be used. Unlike other impact analyses that focus on the changes that occur to the environment and local populations, this analysis also evaluates how the project will protect its employees from exposure to food and water-borne diseases, and communicable diseases. Therefore, one of the first steps is to examine how the camp and facilities will be managed. The other areas that have to be examined are wildlife management, and community health and infrastructure. The following provides questions that should be evaluated during impacts for each topic areas.

WORKER HEALTH

1. *Living Quarters:* If temporary or permanent living quarters will be constructed at the facility, it is necessary to determine whether the quarters are designed to minimize the potential for transmission of communicable disease.
    a. Will the on-site housing comply with international standards with respect to ventilation, space, and sanitation? Will it be designed to prevent communicable disease transmission?
    b. Will there be measures to protect facilities against non-human primate, rodent, and bat infestations – Are pest animals considered in the design? Are there measures to prevent pest wildlife and vectors from entering offices, residences, and facilities?
2. *Canteen:* If the camp will have a canteen, measures to ensure the quality of the food as well as how waste food would be handled should be considered.
    a. Food handling – Will food handling procedures be in place to minimize transmission of any communicable disease in the food preparation or serving process?
    b. Food supply chain and storage – Will food storage be such that food cannot be contaminated by pest animals or insects? Will the food supply chain be inspected to ensure no contamination?
    c. Food waste – Will food be disposed of in a manner that it will not attract pest animals or insects?
3. *Clinic:* If an on-site healthcare facility will be available, measures to address communicable disease and potential outbreaks should be considered.
    a. Capacity (for treatment; for preventive services) – Will the facility be able to diagnose communicable diseases? Will the facility have sufficient capacity to treat an outbreak?
    b. Disease outbreak preparedness plan – Will the facility have an outbreak plan? Will it cover the endemic communicable diseases? Will it address how to deal with unknown diseases? Do health technicians query about contact with animals or their excreta?
    c. Laboratory – Will the on-site clinic have an on-site laboratory? Will the clinic have access to a laboratory for advanced diagnostics if the on-site laboratory is unable to confirm diagnoses?
    d. Will the clinic communicate and share information with the local health facility about infectious disease incidences and unusual illnesses? Will it provide weekly surveillance data to the local health authority?
4. *Waste Management/Pest Control:* All camps and facilities have to manage waste. Improper waste management can attract pest or nuisance animals. Aspects of waste management to consider are listed below.
    a. Landfill management – Will international or local standards be used for the construction and operation of the landfill? Will the landfill be managed so that it does not attract pest animals?
    b. Trash management – Will garbage be managed so that it will not attract pest animals? (covered containers, picked up regularly)
    c. Pest control measures – Will the facility have a pest management control program to address pest/nuisance animals and other vectors?
    d. If agricultural production is allowed within a concession:
        i. Will there be measures to protect livestock from wildlife?
        ii. Will there be measures to exclude wildlife from crops or fruit trees?
        iii. Will there be measures to exclude wildlife or pests from crop storage areas?
5. *Water management*: Water may not only be a habitat for insect vectors. It can also be contaminated if not properly stored.
    a. Vector control measures – Will measures be in place to minimize the amount of standing water

WORKER HEALTH
that could provide vector habitat? b. Water purification – Will drinking water be treated? c. Water storage – Will water storage be secure from potential contamination? d. Other wastes - Are wastewater, sewage, food, and any other waste materials disposed of according to local or IFC/World Bank standards?[1]

BIODIVERSITY/WILDLIFE MANAGEMENT
6. *Wildlife Species and Pathogens:* All wildlife species may host pathogens; however, not all will adversely affect people. *a.* Are the wildlife species present known to host pathogens of concern for people?
7. *Biodiversity monitoring and management strategy*: Habitat changes, such as creating corridors or fragmenting habitat can alter biodiversity, favoring animal species that are more tolerant of people or that seek out man-made resources, such as rodents. Some of these types of animals are known to host zoonotic diseases. a. Will the biodiversity management program consider animals that carry zoonotic diseases, such as rodents? b. Will hunting be allowed on the concession? Within the project footprint? c. Will there be an internal system for reporting wildlife morbidity or mortality? Will there be an external system in place for reporting wildlife morbidity or mortality to wildlife authorities?

COMMUNITY HEALTH
8. *Community Clinic*: Many on-site workers are from the local communities, so infectious diseases in the community can spread to the workplace. Community health can be affected by the influx of workers and other migrants. a. Do the local communities have a health care facility? b. Does the community health care facility have the capacity and equipment to address the health needs of the communities it serves? c. Does the health care facility track local disease outbreaks? Does it have a laboratory? Does it have access to a laboratory for advanced diagnostics for unknown diseases?
9. *Community Infrastructure:* Is the community vulnerable to infectious disease transmission due to deficiencies in its infrastructure? Is the infrastructure adequate to address the needs of the existing population and the anticipated growth in population? a. Do the communities have features to prevent pest/nuisance animals from accessing agriculture and food storage? Community waste disposal? Drinking water sources? b. Does the community have a sanitation system? c. Does the community maintain a landfill? d. Do the communities have adequate drainage to prevent creation of vector habitat?
10. *Community Practices:* Is the community vulnerable to infectious disease transmission due to cultural practices? a. Does the community have a bushmeat market or involvement in other wildlife trade? b. Does the community engage in subsistence hunting? c. Does the community practice traditional activities that could facilitate the spread of communicable diseases (e.g. burial practices)?
11. *Community Food Supply:* Will the project be feeding its workers? The presence of a large-scale project during both construction and operations could put increased demands on food suppliers locally. As a result, prices could rise and make locals look to bushmeat and forest products to supplement their food supplies.

[1] *Water and sanitation, including wastewater and sewage*:
http://www.ifc.org/wps/wcm/connect/e22c050048855ae0875cd76a6515bb18/Final%2B-%2BWater%2Band%2BSanitation.pdf?MOD=AJPERES

Waste Management, including food waste, trash, landfills:
http://www.ifc.org/wps/wcm/connect/1cd72a00488557cfbdf4ff6a6515bb18/Final%2B-%2BWaste%2BManagement%2BFacilities.pdf?MOD=AJPERES&id=1323162538174

COMMUNITY HEALTH
• What are the local sources of agricultural goods? • What are the local sources of protein? • Are there sufficient sources of both to accommodate the increased demand of the project? • What will be the sources of the project's food?

The table on the following page provides a cross-walk of where information from this analysis could be added to an ESIA or an HIA.

Analysis Area	ESIA Section	HIA Section	New Analysis Required
Worker Health			
Living Quarters	Project Description	Respiratory and Housing	Compliance with International Best Practices or local requirements for housing.
Canteen – Food safety/security	-	Food & nutrition	Compliance with International Best Practices or local requirements for food.
Food Management (storage and disposal)	Waste Management or Terrestrial Biological Resources	Food & nutrition/Vector-related impacts/soil, water, & sanitation	Adequacy of food protection to prevent contamination and not attract pests (animals and insects).
On-site Clinic	-	-	Evaluate the adequacy of the clinic and community infrastructure to identify and address outbreaks
Waste Management	Hazards and Public Safety or Waste Management	Vector-related impacts/soil, water, & sanitation	Adequacy of waste management to prevent attracting pests (animals and insects)
Water Management	Water Resources/Waste Management	Soil, water, & sanitation	Compliance with International Best Practices or local requirements for water, and waste management Adequacy of protection of water resources to prevent contamination from animals, not provide vector habitat, and not attract animals
Biodiversity/Wildlife Management			
Wildlife Endemic Zoonotic Diseases	Terrestrial Biological Resources	Community Profile – Communicable Diseases/Veterinary Medicine	Are local wildlife species present that are known to harbor zoonotic pathogens of concern?
Biodiversity Management: Wildlife population as a result of habitat changes	Terrestrial Biological Resources	Veterinary Medicine	How changes in habitat and biodiversity can change wildlife dynamics and increase/decrease wildlife communities and/or populations that may harbor zoonotic pathogens of concern to humans.
Biodiversity Management: Bushmeat Policy	Terrestrial Biological Resources – Management and Mitigations	-	Bushmeat hunting can increase exposure to zoonotic pathogens
Community Health			
Community Clinic	Socioeconomics, Utilities and	Health services, infrastructure, and	Evaluate the adequacy of the clinic and community infrastructures to

Analysis Area	ESIA Section	HIA Section	New Analysis Required
	Infrastructure, and/or Project-Induced Migration Risk Analysis	capacity	identify and address outbreaks.
Community Infrastructure			Evaluate the adequacy of the infrastructure with respect to preventing or facilitating the spread of communicable or other diseases
Community Practices	Cultural Heritage	Cultural Health Practices	How cultural practices can increase the potential exposure to zoonotic pathogens
Community Food Supply	Socioeconomics	Food & Nutrition	Will the increased food demand of the project result in increases in food prices? Will this result in locals seeking forest/wildlife based protein sources?

Cumulative impacts are those impacts that could result from the additive impacts from past, existing, and reasonably foreseeable projects. These types of impacts are often difficult to evaluate because they require looking beyond the boundaries of the project and examining historical context and potential future projects in the region. Cumulative impacts that could occur that would be associated with increasing the potential exposure to zoonotic pathogens:

1. If the combination of existing and new projects sufficiently change the habitat such that species that host pathogens of concern are favored. If wildlife habitat is removed completely then many species would not survive; however, other species may become established and/or become more abundant (e.g. many rodent species thrive in human habitats).
2. If the existing community infrastructure is already stressed or inadequate, the addition of one new project may or may not add further stress, but if multiple projects are planned for the same general area, the community infrastructure could be stressed to the point that systems begin to break down.

Action Plan

Preventing or minimizing exposure to emerging or existing infectious pathogens of zoonotic origin should be addressed at multiple levels. Appendix B includes representative mitigation measures that could be included in an Action Plan.

At a company/community/regional level, mitigation measures should focus on:

- Maintaining intact habitats and preserving biodiversity
- Educating and institutionalizing general public health measures to prevent infectious disease transmission and outbreaks
- Preparing for disease outbreaks

Preparing for disease outbreaks not only involves having an outbreak plan, but also establishing and maintaining communication networks with health care providers, local governments, NGOs, and other companies and industry groups. This may take the form of joint simulations, meetings, phone networks, designated points of contact and trigger points, standing task forces, among other approaches.

For individuals, mitigation measures should focus on preventing direct or indirect contact with wildlife or their excreta by:

- Not creating habitat or food sources for wildlife or pests where people live and work
- Limiting or preventing contact with wildlife or their excreta

- Institutionalizing basic public health control measures to minimize the transmission of pathogens
- Educating individuals to safeguard against pathogen transmission

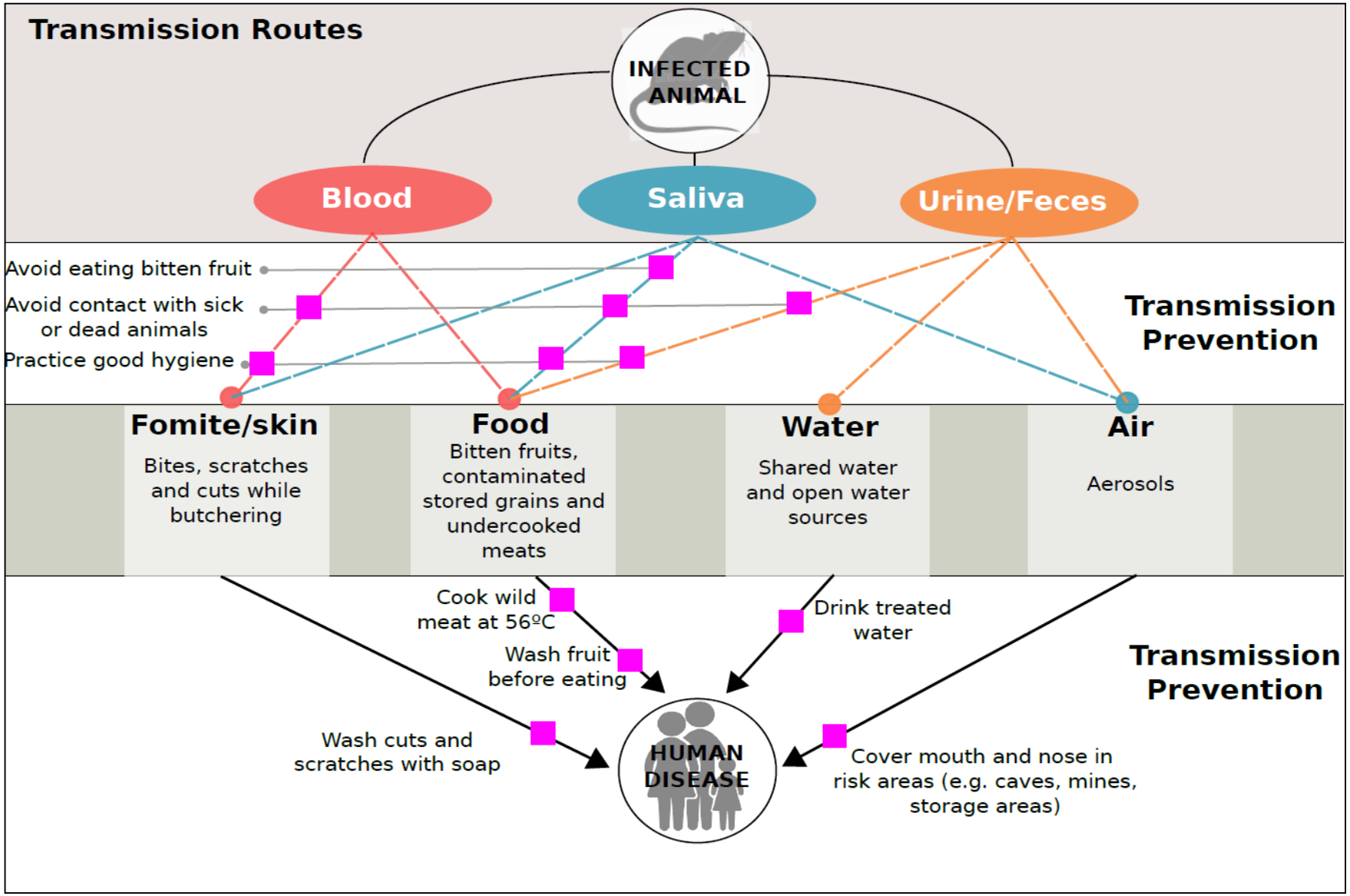
Figures 4 and 5 below provide frameworks to use in formulating prevention / mitigation strategies.

While preventing exposure is preferable, all action plans should have a preparedness plan for disease outbreaks. The Ebola outbreak provided examples of actions that facilities can take to limit transmission during an outbreak such as:

- Installing hand washing facilities with potable water and soap at the entry point to all camps, offices, canteens, and residential areas, and educating the workforce to use them.
- Installing temperature screening devices at the entrance of camps.
- Providing accurate evidence-based information about diseases to dispel rumors.

General use of hand washing facilities can reduce transmission of multiple communicable diseases. Temperature monitoring during the Ebola epidemic identified other febrile diseases.

Figure 4: Practices individuals can take to reduce potential for zoonotic disease transmission



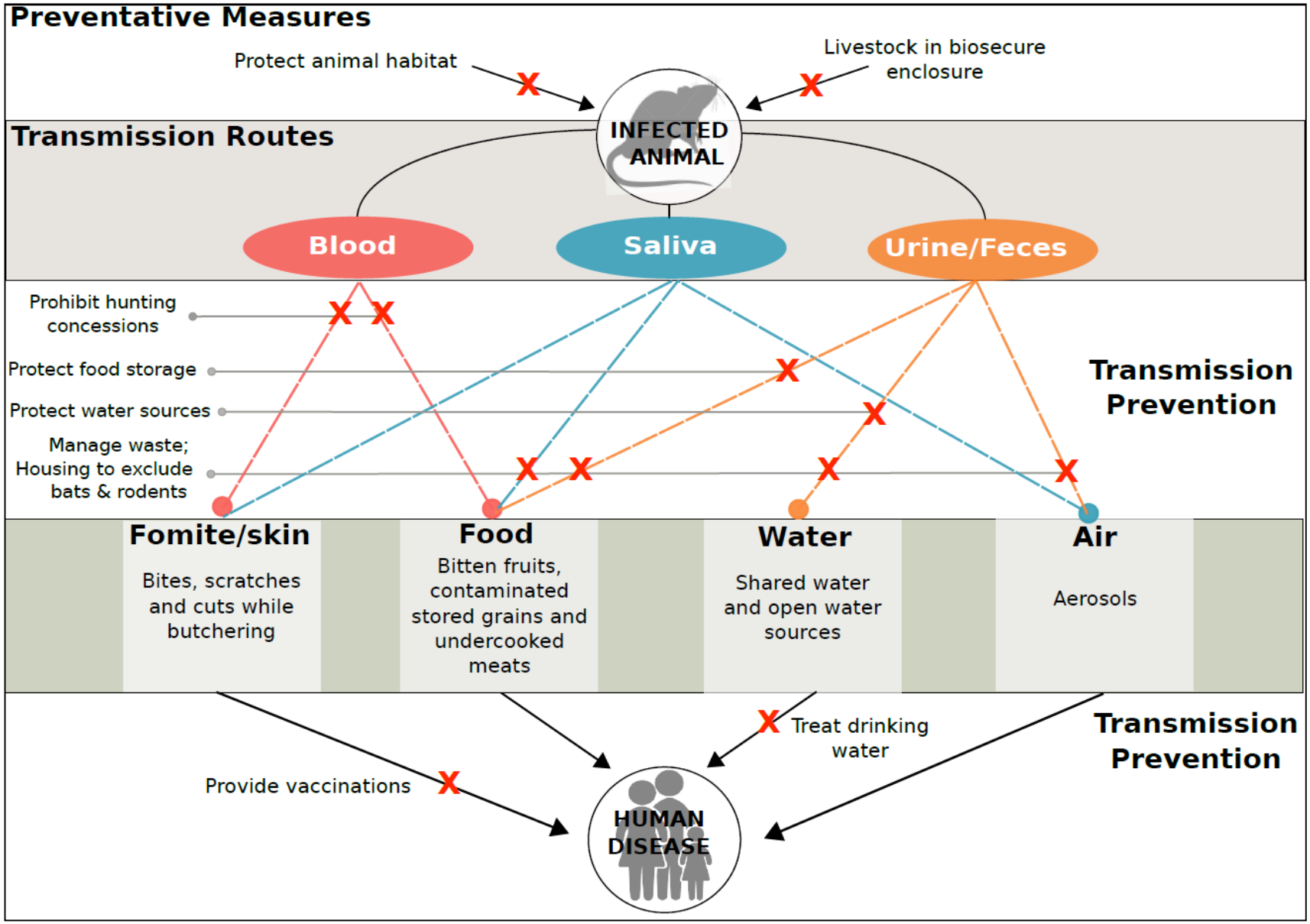


Figure 5: Practices companies can take to mitigate the potential for zoonotic disease transmission

Monitoring and Evaluation

Monitoring and evaluation (M&E) of any mitigation strategies should be implemented and evaluated. Key performance indicators used could be: structural, process, and outcome based. The following are potential key performance indicators for successful emerging infectious disease mitigation:

Structural

- Staff housing characteristics (adequate and appropriate space per individual, sanitation, food storage)
- Landfill characteristics (adequate size; appropriate cover to discourage pests; appropriate and adequate runoff control; appropriate distance from housing, village, and other human-used facilities)
- Waste bins (covered and secure to prevent raiding by wildlife, and emptied regularly)
- Reduction or elimination of open water (gutters, ditches, water containers, etc.)
- Facility structure characteristics (measures to discourage bat roosting and rodent invasion)

Process

- Implementation of Biodiversity Monitoring Plan and establishment and enforcement of policies on bushmeat and other wildlife trade
- Implementation of integrated pest management to reduce animal pest and insect abundance, including implementation of appropriate waste management procedures to prevent attracting insects and vermin
- Implementation of food – procurement, safety/security, handling, disposal – procedures to eliminate potential contamination by pests
- Operational disease monitoring, surveillance, and reporting plan
- Operational disease outbreak plan that is evaluated annually
- Compliance with local and national health reporting requirements. This should be consistent with the World Health Organization International Health Regulations

Outcome

- Maintenance of intact habitats and biodiversity around the facility
- Number of infectious disease events or outbreaks
- Number of pests trapped or frequency of pests observed
- Number of adverse wildlife encounters (e.g. bites, scratches)
- Amount of on-site hunting
- Number of occurrences of bushmeat procurement
- Amount of bushmeat and animal products destined for wildlife trade found in company vehicles or at exit gates

APPENDIX A: Zoonotic and Vector-Borne Viruses of Concern

The following table provides an example of the types of information that should be assessed to identify wildlife pathogens that have been identified in and around the project area, potential pathogens associated with wildlife endemic to the project area, and the corresponding transmission pathways of infection associated with these pathogens.

These types of country level tables can be generated from WHO Global Health Observatory, FAO EMPRES, OIE WAHID databases, and may be supplemented by a tool on HealthMap (http://www.healthmap.org/en/). Otherwise, a literature search will have to be conducted by country, pathogen and research databases (e.g. Olival et al. *in review*, EcoHealth Alliance).

The presence of these types of pathogens could be incorporated into a company's risk assessment program.

Table A-1. Examples of Known Zoonotic and Vector-Borne Viruses of Concern. *This table is designed as a first level "Hazard Identification" element*.

Virus	***Transmission pathway***	***Examples of known species affected***
Marburg Virus	Direct contact with infected animal	Franquet's epauletted fruit bat *(Epomops franqueti)*, Hammer-headed bat (*Hypsignathus monstrosus)*, Egyptian fruit bat (*Rousettus aegyptiacus),* Great long-fingered bat *(Miniopterus inflatus)*
West Nile Virus	Vector-borne	*Straw-coloured fruit bat (Eidolon helvum),* humans
Ebola Virus	Direct contact with infected animals	Bats: Straw-coloured fruit bat (*Eidolon helvum)*, Franquet's epauletted fruit bat *(Epomops franqueti)*, Hammer-headed Fruit Bat (*Hypsignathus monstrosus)*, Peter's Dwarf Epauletted Fruit Bat *(Micropteropus pusillus)*, Little Collared Fruit Bat *(Myonycteris torquata),* Egyptian fruit bat *(Rousettus aegyptiacus),* Non-human primates: Gorilla *(Gorilla gorilla)*, chimpanzee (*Pan troglodytes)* Humans
Chikungunya Virus	Vector-borne	Bats: Egyptian fruit bat *(Rousettus aegyptiacus),* Cape Leaf-nosed bat or Sundevall's roundleaf bat or Common African Leaf-nosed Bat *(Hipposideros caffer)* Rodents: Natal Multimammate Mouse *(Mastomys natalensis),* Humans
Simian immunodeficiency virus (SIV)	Direct contact with infected animals	Non-human primates: *Cercopithecus spp., Lophocebus albigena,* Drill *(Mandrillus leucophaeus)*, Mandrill (*Mandrillus sphinx)*, Guerza (*Colobus guereza), chimpanzee (Pan troglodytes)*
Monkeypox Virus	Direct contact with infected animals	Non-human primates: *Cercopithecus spp.*, Rodents: Northern Giant Pouched Rat (*Cricetomys spp.*),

Table includes examples of known zoonotic pathogens in mammals and birds as documented in the scientific literature (2000-2011).

APPENDIX B
Example Preventative Mitigation Measures

This table presents examples of preventative mitigation measures that can be implemented for a large project within a community in a rural setting. It is not meant to serve as a template, but rather to illustrate some of the actions that can be taken.

C&C = Company and Contractor Health Plan	PACs = Potentially Affected Communities

Timing:

Table B-1 Illustrative Mitigation Measures

	Timing	Action Plan		Responsibility[2]	Collaborating Agency or Organization	Indicators	Surveillance Method
		C & C	PACs				
Emerging Zoonotic Disease Transmission							
Risk: Direct contact with infected animals (Direct contact with infected animals can occur while working outdoors, in adits or caves, in agricultural settings, in locations where food or waste is stored)							
Institute a no-bushmeat-hunting policy within the concession if possible. Otherwise discourage bushmeat hunting and enforce local bushmeat regulations in areas of company control.	C→DC	X		Company	Local environ-ment department	Presence/absence of on-site poaching, # of confiscations	Company security or Community Relations Department

[2] There may be instances where the responsibility is the company's, but partnering with organizations within government or NGOs can make training and capacity building more effective.

Table B-1 Illustrative Mitigation Measures							
	Timing	**Action Plan**		**Responsibility[2]**	**Collaborating Agency or Organization**	**Indicators**	**Surveillance Method**
		C & C	**PACs**				
Train workers about issues associated with bushmeat hunting – in particular species and their associated diseases, and discourage the purchasing of bushmeat	C→DC	X		Company education department	Local environment department	Presence/absence of on-site poaching, # of confiscations	Company security or Community Relations Department
If workers have to enter areas with known concentrations of bats or rodents (e.g. adits, caves, etc), conduct an assessment of the potential for exposure to wildlife and select appropriate PPE to prevent contact with feces and urine and bodily fluids (e.g. in a cave setting).	C→DC	X		Company health and environment department	Local environment department	Number of workers operating in areas with known concentrations of rodents or bats that use PPE	
Educate project workers about zoonotic disease risks, how to avoid encounters with wildlife, and what to do if bitten, scratched, etc.	C→DC	X		Company education department	Local environment department/health department	Number of workers trained/ Number of adverse encounters	Incidence recorded at company clinic
Minimize habitat fragmentation/creation of edge through limiting road development	D→O	X		Company	Local Environmental Department.	Length of linear corridor	Annual mapping
Maintain biodiversity through implementation of a biodiversity plan	D→DC	X		Company	Local Environmental Department.	Species counts	Semi-annual inventories
Monitor on-site agriculture for pest invasion.	C→O	X		Company	Local environment department/health department	Presence/absence of pests; crop destruction	Company environmental audit
Conduct training with local communities about issues associated with bushmeat hunting and proper methods to butcher	C→DC		x	Company education department	Local environment department	Number of people trained	
Conduct educational campaigns with local communities about zoonotic disease risks, how to avoid encounters with wildlife, and what to do if bitten, scratched, etc.	C→DC		x	Company education department	Local environment department/health department	Number of locals trained/ Number of adverse encounters at local clinic	Incidence recorded at local clinic

Table B-1 Illustrative Mitigation Measures							
	Timing	**Action Plan**		**Responsibility[2]**	**Collaborating Agency or Organization**	**Indicators**	**Surveillance Method**
		C & C	**PACs**				
Establish internal and external data collection and reporting mechanism for wildlife morbidity and mortality	C→DC	X	x	Company environment department	Local environment department/health department	Number of reports	Worker /community reporting
Conduct educational campaign about wildlife conflict mitigation & domestic animal biosecurity	C→DC		x	Company education department	Local natural resource department	Number of people trained	
Risk: Indirect contact with infected animals (Indirect contact can occur through consumption of food or liquids that have been contaminated with animal excreta or from insect vectors)							
Review food safety and security procedures	D→O	X		Company	Local health department	Food safety procedure implemented	Food safety audit
Review food storage methods and protections	D→O	X		Company	Local environment department/health department	Presence/absences of pest prevention measures	Food safety audit
Review waste disposal and management	D→O	X		Company	Local environment department/health department	Daily cover, pest control	Environmental Management Review/Audit
Review housing design to ensure adequate measures exist not to promote or facilitate infectious disease transmission	D->DC	X		Company, Engineering Design	Local health department	Occupants per room, Food storage, Sanitation	Housing audit
Conduct health education programs for project workers regarding infectious diseases transmission	C→DC	X		Company Health or Education Department	District Health Officer	Number of workers trained	Worker testing; audit practices, incidence of infectious diseases
Conduct health education programs for project workers regarding food safety.	C→DC	X		Company Health or Education Department	District Environmental Health Officer	Number of workers trained	Worker testing; audit practices, incidence of food-borne illnesses

Table B-1 Illustrative Mitigation Measures							
	Timing	**Action Plan**		**Responsibility[2]**	**Collaborating Agency or Organization**	**Indicators**	**Surveillance Method**
		C & C	**PACs**				
Assist with providing food sanitation awareness materials to local district environmental sanitation officers for educational sessions with food handlers and slaughterhouses, particularly vendors who sell food to project workers.	C→O		x	Company Health or Education Department	Local Environ-mental Health Department.	Food Handler practices	Audit of food handler practices
Implement an entomological survey program for insect vectors at the facility and in the PACs	C→DC	X	x	Company	Country health services: vector-control division	Entomological infection rate/ parasite prevalence rates in children	Review survey reports
Risk: Changes to the surrounding communities due to the presence of a facility that could increase contact with wildlife (direct contact) and/or result in increased transmission of infectious diseases that occur locally (amplification)							
Assist local community with spatial planning (location of agricultural, waste disposal, potable water)	D→DC	X	x	Company Engineer/ Planner	Local Environ-mental Health and Planning Departments.	Local spatial plan in place	Periodic reviews of the spatial layout
Assist the local community to plan infrastructure and utilities (waste disposal, potable water, health care facilities)	D→DC	X	x	Company Engineer/ Planner	Local Environ-mental Health, Infrastructure, and Utilities Departments.	Number of plans developed and implemented	
Work with community representatives to improve vector management (e.g. control of mosquito breeding grounds in stagnant water and maintaining drainage during rainy seasons).	D→DC	X	x	Company Engineer/ Planner	Local Environ-mental Health Department.	Number of meetings/workshops	Site audit
Provide support to district health vector control programs	D→DC	X	x	Company Environmental Health Officer	Local Environ-mental Health Department.	Number of meetings and level of support	

Table B-1 Illustrative Mitigation Measures							
	Timing	**Action Plan**		**Responsibility[2]**	**Collaborating Agency or Organization**	**Indicators**	**Surveillance Method**
		C & C	**PACs**				
Provide assistance with retrofitting or designing boreholes so that they comply with local regulations, are protected against potential contamination, and do not create vector breeding habitat	D→DC		x	Company Environmental Health Officer	Local Environ-mental Health Department.	Number of boreholes that are compliant	
Collaborate with local waste management services to develop non-hazardous waste management plans for local communities that can include: • Sufficient garbage cans and dumpsters • Garbage stored in rodent-proof containers • Sanitary and solid waste is collected daily and covered daily with a solid layer of soil (15 to 30 cm) • Appropriate container program to avoid waterborne insect breeding • Prohibit moving large quantities of foodstuffs to animal farmers to avoid generating rodent or reptile habitat	D→DC		x	Company Environmental Health Officer	Local Environ-mental Health Department.	Number of plans in place and imple-mented	Site assessment
Support the training of local community health personnel in infectious disease surveillance and outbreak response	D→DC		x	Company Health Officer	Local Health Department	Number of people trained Presence/absence of plan	Presence of a functioning disease surveillance program
Support improvement of local market biosecurity measures	D→DC		x	Company Health Officer	Local Health Department	Improved bio-security measures	

Table B-1 Illustrative Mitigation Measures							
	Timing	**Action Plan**		**Responsibility[2]**	**Collaborating Agency or Organization**	**Indicators**	**Surveillance Method**
		C & C	**PACs**				
Support local land-use planning and manage project-induced population influx to preserve areas of intact habitat	PD->O	X	X	Company Corporate Social Responsibility Officer	Local Planning Department	Presence/absence of intact habitats and their size	Identify intact habitat and then track their integrity

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