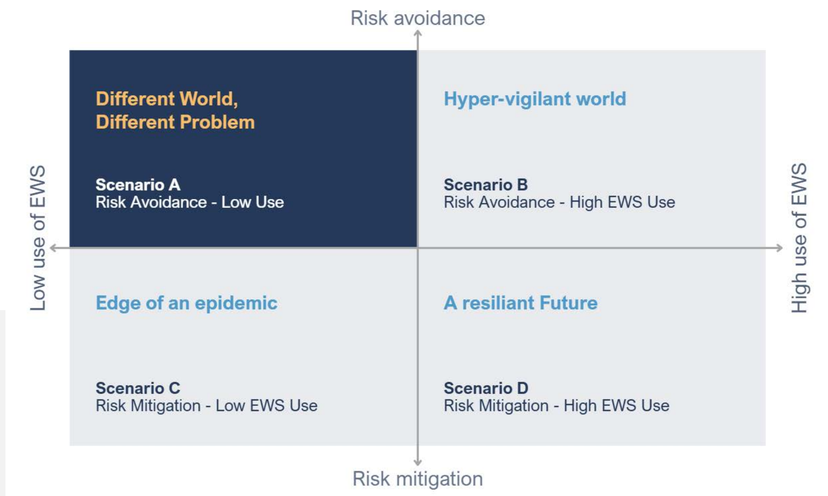
Different world, different problems
Foresight Scenario



Description

It is the year 2050, and climate change is here to stay. Europe, particularly the Mediterranean countries suffer frequent and intense droughts and water scarcity, leading to desertification. Rising sea levels have diminished coastal plains, big fires have destroyed most woodlands and Europe overall has suffered big biodiversity loss and an extinction of most wild animals. Open agriculture is not anymore possible. Where tourism does occur, it is highly regulated, particularly when animals are involved. Agriculture has moved to vertical farming under controlled conditions and so is fish farming to manage threats to food production. Animal farming is now banned. This has decreased the natural habitat, the breeding and feeding grounds of sand fly populations.

More than 90% of the population live in cities and satellite towns as appreciation of climate-related health conditions, but also of the potential contamination of waters and the prevalence of vector-borne diseases, have decreased. Animal disease-reservoirs that live in the city such as rats and racoons are monitored and controlled by veterinarian public authorities. People spend most of their time indoors protected from the elements. This high concentration of people in cities has heightened everyone's attention to the potential risks of any communicative diseases and the crucial role of prevention, control, and elimination of any such risk before transmission. Human cases of *Leishmania* have drastically decreased and *Leishmania* in humans is on the edge of being eliminated. This is thanks to surveillance and early diagnosis, made possible by the fact that citizens take an active role in providing screening data for seroprelavance for both themselves and their pets. Veterinarians are also more aware on preventive measures (prophylaxia). In addition, a preventive *Leishmania* vaccine for humans is on the edge of being commercialized and the discovery of a medication that makes the human blood poisonous to sand flies is also an imminent option. Training programs for vector-borne diseases are part of everyday life, school programs and community education. Misinformation is uncommon. In hard-to-reach rural areas, younger people received targeted training to champion and drive the proactive response among the wider population. Rapid and easy-to-use protective and preventative measures for animals have been provided free-of-charge for some time, which increased use. One example is the rapid test for *Leishmania* detection. Identified infected dogs (or domestic animals) that in the past were eliminated (killed) are now vaccinated and regularly monitored for a host of vector-borne diseases. Genetically modified pets are also giving the first steps towards the non-transmission of viruses or parasites. Vector repellent and treatments are mandatory in endemic regions. Citizens involved in animal husbandry, have played a critical role in the collection of sand fly data, by facilitating fly trapping. They work in close collaboration with local government, health departments and environmental experts. The close collaboration with veterinarians is crucial for effective monitoring of *Leishmania*.

Climate disasters in neighbouring countries led to mass migration of people and animals from Leishmaniasis endemic countries but people live within their communities and high level of understanding of the disease, drug discovery and disease management strategies has minimised the risk contamination. This is thanks to a closer control of people moving into Europe and public health policies that are fully inclusive of migrants and equitable across all socio-demographic groups, with targeted and customised information based on specific-population needs. Additionally, screening for Leishmaniasis (among other diseases) is in place for everyone. Some complain about the marginalization of climate refugees, but policy makers are more worried about the potential impact of triggering an epidemic. Modern medicine and advanced healthcare are provided to anyone detected carrying the disease, especially those identified with the deadly variants. New social norms and regulations have resulted to very few people owning companion dogs and leishmaniasis vaccination is compulsory for those who do.

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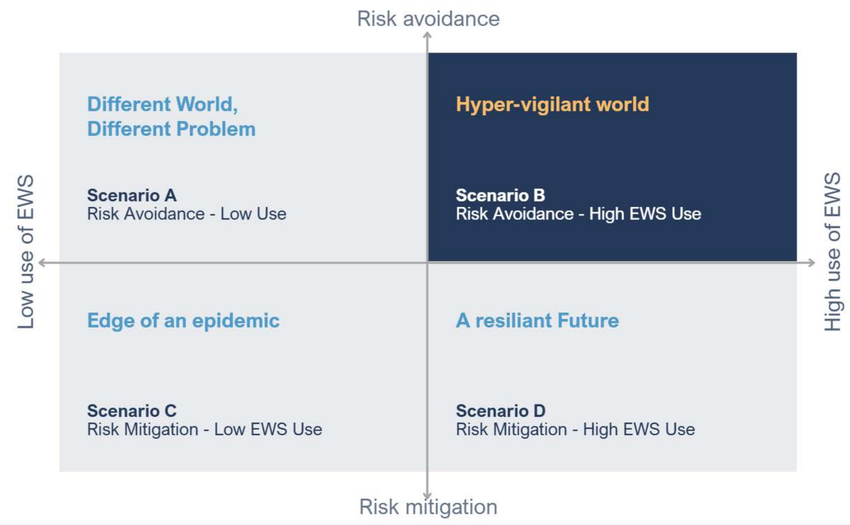
Hyper-vigilant world
Foresight Scenario



Description

It is the year 2050, and climate change is here to stay. Europe, particularly the Mediterranean countries suffer frequent and intense droughts and water scarcity, leading to desertification. Rising sea levels have diminished coastal plains, big fires have destroyed most woodlands and Europe overall has suffered big biodiversity loss and an extinction of most wild animals. Open agriculture is not anymore possible. Agriculture has moved to vertical farming under controlled conditions and so is fish farming to manage threats to food production. Animal farming is now banned. This has decreased the natural habitat, the breeding and feeding grounds of sand-fly populations.

More than 90% of the population live in cities and satellite towns as appreciation of climate-related health conditions but also of the potential contamination of waters and the prevalence of vector-borne diseases have decreased. People spend most of their time indoors protected from the elements.

This high concentration of people in cities has heighten everyone's attention to the potential risks of any communicative diseases and the crucial role of prevention, control, and elimination of any such risk before transmission. Training programs for vector-borne diseases are part of every-day life, school programmes and community education. The high concentration of people in cities, is also promoting the diversification and increase of smaller pets such as rabbits. Any infected dogs were identified early and eliminated in the past and domestic animals are now vaccinated and regularly monitored for a host of vector-borne diseases.

Climate disasters in neighbouring countries led to mass migration of people and animals from Leishmaniasis endemic countries but people live within their communities and high level of understanding of the decease, drug discovery and disease management strategies has minimised the risk contamination. Some complain about the marginalisation of climate refugees, but policy makers are more worried about the potential impact of triggering an epidemic. Modern medicine and advanced healthcare are provided to anyone detected to carry the disease. New social norms and regulations have resulted to very few people owning companion dogs and leishmaniasis vaccination is compulsory for those who do.

An Early Warning System (EWS) of sand fly-borne diseases is considered a cornerstone of public health management of vector-borne diseases globally and is fully integrated into existing health systems. Citizens regularly utilise EWS, for disease prevention and other broader concerns related to climate change and natural disasters. They consider EWS easy to use in order to access information that offers evidence-driven suggestions on how to effectively plan ahead to prevent possible infections and other adverse health outcomes. Globally deployed sensors provide data to the EWS on a variety of vector-borne diseases hosts. This powers AI-driven EWS that analyse vast amounts of data from diverse sources, including satellite imagery, climate data, geolocated veterinary prescription data, and epidemiological records, to predict leishmaniasis outbreaks and identify high-risk areas and periods. Comprehensive databases containing genomic sequences of *Leishmania* parasites and sand fly vectors have been established worldwide. This allows for real-time tracking of parasite evolution and vector distribution patterns. AI-driven surveillance systems enable proactive interventions, effectively reducing disease transmission. Because it has been proven to be a very low-cost tool, the EWS is planned to be extended in terms of focus (not only sand flies), meaning that is also a tool that will be used as a monitoring mechanism. Coordinated efforts among governments, non-governmental organizations, research institutions, and pharmaceutical companies have led to the establishment of comprehensive control programs and equitable access to essential healthcare services. Targeted vector control measures, such as genetically modified sand-flies carrying sterilizing genes, for example, have been deployed in endemic regions, significantly reducing sand fly populations. Integrated pest management practices, coupled with targeted habitat modification initiatives, further mitigate transmission risks while preserving ecosystem balance.

climate-health cluster

The six Horizon Europe projects, **BlueAdapt, CATALYSE, CLIMOS, HIGH Horizons, IDAlert, and TRIGGER,** form the climate change and health cluster.

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Edge of an epidemic
Foresight Scenario

Description

By the year 2050, consumer trends toward healthy eating have increased the demand for organic produce and organic farming. The proliferation of organic farming that relies on composting in fields has made farmlands breeding grounds for sand flies. Changes in land use of rural areas have given rise to beautiful woodlands heaving with wild animal life, but also to sources of sand fly-borne diseases (SFBDs) and other vector-borne infestation for locals and their animals, as well as visitors. Climate change has led to extended periods of warm winters even in Northern parts of Europe and humid springs with frequent floods and longer summers which are fertile grounds for the proliferation of sand flies in Europe and the Mediterranean basin. Changes in work practices in Europe also contribute to increased exposure of people to leishmaniasis. While the number of farmers has decreased, there is an increasing number of remote workers and the ever-increasing number of people that want to escape the city and reconnect with nature whether at home or abroad exposing them to health risks. There is a tendency to recreate “nature at home”, with indoor gardening and/or small-scale farming, leaving open the possibility for the emergence of sand flies indoors. The new building approach is more resilient to climate change, meaning more use of air conditioning and heating systems, promoting an ideal temperature for the development of sand flies, all year long. With such new development, sand flies start to feed on humans more, rather than on animals. Thus, there is a possibility for the increase of human *leishmania* in humans. Climate change has also triggered other natural disasters, that led to mass migration of people and animals from Leishmaniasis endemic countries into Europe. Mass human migration has led to large number of people living in poor living conditions that increase their exposure to sand flies and the likelihood of contracting SFBDs. Coupled with the mismanagement of stray animals (through legislative gaps and in practice), this has led to unvaccinated and untreated dogs that contract and spread SFBDs. In addition, the lack of specific legislation regarding dog ownership and management facilitates the spread of Leishmaniasis. The possibility of contagion from vector-borne, water borne, and food borne diseases taking a toll on society is by now considered a common threat.

Citizens are largely unaware of the diseases associated with sand flies, while others have an inaccurate understanding of the challenges faced, based on misinformation circulating on social media. Nonetheless, informed citizen organisations demand that governments monitor such diseases and set effective prevention measures to protect public health (a simple measure is encouraging people to walk their dogs during times when sand fly activity is low, to reduce the risk of transmission) For politicians, the political cost of not acting on this is increasing but the relative efficacy of alternatives is unclear. As cases proliferate, public’s interest and understanding (literacy) about human and animal SFBDs increases as are voices demanding preventive public health strategies and measures. While public health services struggle with loss of institutional knowledge and vector control continuity, due to high turnover of personnel, health managers seek new ways to manage the situation, however, they are torn between competing social policy demands on public investment.

An early warning system (EWS) is one such measure that could be considered. However, public knowledge is still lacking about what EWS apps can do to protect public health, and this affects popular demand for investment in EWS by those responsible for public health management. The public tend not to use disease monitoring information and also find such information systems hard to access and use. This is sometimes driven by poor internet access or lack of exposure to high-tech tools, particularly in rural endemic areas. Governments are worried about the impact EWS information may have on people’s mindset, particularly the risk to cause panic and how this may affect economic activity and even tourism. Furthermore, the lack of reliable data is driving a sense of mistrust in data-driven solutions among the public, associated with issues related to data privacy and security. Taking all these considerations, different parties are reluctant to adopt the EWS. In addition, with ever increasing costs of living, increasing unemployment and an ageing population, government income is low and the demands for public spending ever increasing. Is this the best value for money solution to adopt? Moreover, such EWS systems are seen ‘trojan horses’ for government surveillance especially since a recent EU directive to adopt such systems as a means to coordinate climate adaptation efforts at a national level. Sudden demands by governments for people to change their habits and behaviours to assist the nation to adapt to climate change are met with suspicion and there is a tendency to disregard their advice.

Another solution could be to reintroduce pesticides in agriculture, but this is by now illegal as laws around the use of pesticide has changed, they will contaminate the soil and waters and public opinion is by now firmly against them. Some experts talk about nature-based solutions introducing natural predators, traps or insect sterilisation schemes. Experts also recommend specific training for farmers regarding cleaning practices to increase hygiene among animals, but uptake is low.

Another would be to decrease overall human activity in rural areas by shifting totally from open agriculture to vertical farms and from animal farming to emerging 3D printed meat production, but such measures cannot cater for the whole population yet at affordable prices. Community engagement and education programs leverage interactive multimedia platforms and virtual reality simulations to raise awareness about vector-borne diseases, including leishmaniasis prevention and treatment. There is a growing sentiment to avoid nature overall or take precautions to prevent contamination.

There is a lack of advanced diagnostic tools and inadequate use of technology in monitoring and controlling vectors. It would be ideal if there was a vaccine and drugs to safely manage Leishmaniasis in people, but these are still in clinical trial. The prospects however are good. A vaccine against Leishmaniasis is close. Nanomedicine enables targeted and sustained release of anti-leishmanial agents to infected cells, bypassing systemic toxicity that has been the problem for years. Progress towards personalised, genomic based drug regimens are likely to ensure optimal therapeutic outcomes while minimizing drug resistance. Precision medicine approaches tailored to individual patients' genetic makeup and parasite strains is also on the cards both for people and dogs. However, it is important to avoid inequities in healthcare access, as it can exacerbate the impact of the disease.

Dog vaccination against it is compulsory, so at least transmission from infected companion animals is minimised. The increasing costs of the upkeep of dogs and this makes people abandoning them especially when in recessions putting a pressure on dog shelters or increasing the number of stray dogs in some countries. Governments are now considering a national programme of pet vaccination schemes, but this is costly.

Travel Health Advice is issued regarding the risks to travelling to endemic countries and this is part of the travel booking procedures to ensure people are informed. Health checks are compulsory upon their return. Tourists from endemic countries are required to provide a ‘clean PCR test’ to enter non-endemic countries.

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A resilient future
Foresight Scenario

Description

By the year 2050, consumer trends toward healthy eating have increased the demand for organic produce and organic farming. The proliferation of organic farming that relies on composting in fields has made farmlands breeding grounds for sand-flies. Changes in land use of rural areas have given rise to beautiful woodlands heaving with wild animal life, but also to sources of sand fly-borne diseases (SFBDs) and other vector-borne infestation for locals and their animals, as well as visitors. Climate change has led to extended periods of warm winters even in Northern parts of Europe and humid springs with frequent floods and longer summers which are fertile grounds for the proliferation of sand-flies in Europe and the Mediterranean basin. Changes in work practices in Europe also contribute to increased exposure of people to parasites causing leishmaniasis. While the number of farmers has decreased, there is an increasing number of remote workers and the ever-increasing number of people that want to escape the city and reconnect with nature whether at home or abroad exposing them to health risks. The domestication of wild animals has increased (e.g. Foxes, jackals, porcupine), leading to an increase of leishmaniasis. The number of people traveling abroad has increased, including those where people travel with their pets. Until recently the control measures around this were loosely enforced. Now, a passport for dogs is mandatory, in the attempt to trace dogs travel abroad. In some cases, quarantine for the animal is also mandatory, as well as regular laboratory testing. Climate change has also triggered other natural disasters, that led to mass migration of people and animals from Leishmaniasis endemic countries into Europe. leading to large number of people living in poor living conditions that increase their exposure to sand flies and the likelihood of contracting SFBDs. Coupled with the mismanagement of stray animals, this has led to unvaccinated and untreated dogs that contract and spread SFBDs. Due to uncertainties and lack of information on the one side, some dog's owners take extreme measures such has having their pet euthanized (cull), due to suspicion of dogs having leishmaniasis. On the other side, some dog owners seek other solutions (instead of cull), when fearful for their dogs' life. The possibility of contagion from vector-borne, water borne, and food borne diseases taking a toll on society is by now considered a common threat.

Citizen organisations demand governments to monitor such diseases and set effective prevention measures to protect public health, driven by growing concerns related to climate change, natural disasters and migration of people. For politicians, the political cost of not acting on this is increasing but the relative efficacy of alternatives is unclear. Government resources for public services are becoming increasingly limited and demands increasingly unpredictable. When it comes to healthcare, Investments in prevention measures vis a vis investment in the capacity of healthcare systems, i.e. medical facilities, diagnostic capabilities, and healthcare workforce training, is a conundrum. Increasing human and animal resistance of contracting leishmaniasis, is a potential solution, and the development of a human-vaccine for deadly versions of Leishmaniasis looks promising. How to respond to the growing burden of vector-borne diseases and which combination of solutions will bring the best results, are still open questions. However, there is a tendency to focus on vectors and reservoirs (such as dogs). To raise awareness without raising public panic is key. Early education and awareness programs on taking proactive measures is part of formal education but their impact and adherence to such measures varies.

An EU-funded and state-run early warning system (EWS) is one such measure to be considered. The climate crisis induces uncertainties. An EWS can provide “a perceived” sense of safety to people. The EWS is part of Europe’s toolkit to implement national adaptation strategies while minimise disruption of human activity allowing people to normally live their lives when chances to get infected is low, take precautions or avoid activity in a particular area when chances are high. Time and money investment in setting up and maintaining a sensor network to provide data would be minimal even at global scale utilizing drones and robots. The AI-driven EWS can interpret data at low cost in real-time, since it analyses vast amounts of data from diverse sources, including satellite imagery, climate data, geolocated veterinary prescription data, and epidemiological records. The EWS could allow for localised sand-fly population management techniques (supported by local governments) at crucial times to minimise environmental impacts while effectively containing the spread of diseases. It can also provide insights into socio-economic risk factors associated with endemic regions. While nothing could safeguard public health 100%, early warning can take the load off the health system by helping to manage impacts in a timely fashion and giving those responsible for public health management enough time to organise and mobilise resources to coordinate a response. It offers a safer solution, for public health professionals, compared to dangerous pesticides. It can also provide undisputed necessary evidence as a foundation for international collaboration and harmonising public health mandates to manage leishmaniasis health threats globally. Standardised data collection protocols and harmonised data analysis and integration will also need to be agreed on and supervised and financing its ongoing maintenance will be important (as it would be in with any solution). Introducing changes in a health system is usually cumbersome especially when new skills and training is required across primary care and its success hinges on regaining public trust and ensuring community engagement, as well as reassuring the public about a number of ethical and privacy concerns.

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