

Managing malaria

Teachers' notes



Overview of the activity

Students are given a scenario where they are allocated the role of malaria programme managers for a community in a malaria endemic area. In groups they must assess the situation facing the community and propose a strategy that will work towards eliminating malaria from the area. The groups must present their proposal to the rest of the class and summarise their reasons for suggesting this strategy.

Estimated duration: 60-90 minutes

If class time is limited, students can be allocated to their groups before the lesson and prepare for the activity as a homework task by accessing the *Malaria Challenge* resource online to gather information on their scenario and possible malaria control strategies they may use.

Group size: 4-6 students

Running the activity

To run the activity you will require:

- *Malaria Challenge* resource and internet access
- Introductory PowerPoint or video
- Scenario sheets (several copies per group)
- Group worksheet
- Student guidance notes
- Group discussion guidelines
- A1 flipchart paper (optional, for groups to present their strategy)

Step 1: Introduction to malaria

Using either the introductory PowerPoint presentation or video provided with the resource, introduce the students to the topic of malaria. Both introductions provide information about:

- what malaria is
- where it is a problem
- who is affected and why.

The resource also touches on the issues about malaria diagnosis and treatment as well as the problem of drug resistance.

After introducing the topic of malaria, outline the activity to the students. Explain that they are going to become malaria programme managers for a community in a malaria endemic area and together will develop a strategy for eliminating malaria from their region.

Step 2: Scenario and role allocation

Divide the class into four groups of 4-6 students. Randomly allocate the scenarios to the groups. For example,

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get the groups to pick a number out of a hat. If you have a large class size, allocate the scenarios to multiple groups. The four scenarios available are:

Scenario 1: Cambodia, Southeast Asia

The group has been made responsible for three border provinces in Cambodia; Koh Kong Province, Perah Vihear Province and Sampovloun operational district. They need to identify the main malaria challenges facing this region and propose a strategy that will reduce the number of cases of malaria in this region.

Scenario 2: Lake Kyoga catchment area, Central Uganda

The group has been made responsible for the Lake Kyoga catchment area of Central Uganda. They need to identify the main malaria challenges facing this region and propose a strategy that will reduce the number of cases of malaria in this region.

Scenario 3: Dar es Salaam region, Tanzania

The group has been made responsible for three municipalities within the Dar es Salaam region of Tanzania. They need to identify the main malaria challenges facing this region and propose a strategy that will reduce the number of cases of malaria in this region.

Scenario 4: Amazonas, Brazil

The group has been made responsible for the Amazonas State, in Northwest Brazil. They need to identify the main malaria challenges facing this region and propose a strategy that will reduce the number of cases of malaria in this region.

Before starting their discussions, the group should nominate the following roles:

- **Spokesperson(s):** the person or persons who will speak on behalf of the group during the feedback session.
- **Scribe:** the person responsible for taking notes on the discussion and completing the group worksheet.

Step 3: Group research and discussion

All members of the group must research one of the malaria prevention methods featured in their scenario using the *Malaria Challenge* resource. They should identify the relevance of the prevention method and its appropriateness to their target region. One suggested method is to allocate members of the discussion group specific research tasks, e.g. student A researches bed nets, student B researches anti-malarial drugs. This will ensure everyone in the group is familiar with at least one topic area and can contribute to the discussion.

Students are recommended to use the *Malaria Challenge* resource to find out about the disease and preventions but additional information is available from the following websites:

- <http://www.nothingbutnets.net>
- http://www.who.int/malaria/world_malaria_report_2010/en/index.html
- <http://www.rollbackmalaria.org/>

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- <http://malarianomore.org.uk/malaria#>

The group must discuss the advantages and disadvantages of the prevention methods and how effective they could be at eliminating malaria in their target region. Before beginning the discussions, you should make the students familiar with the following guidelines.

- Speak for yourself and not for others.
- Allow others to finish before you speak. Listen well.
- Ask questions as well as making statements.
- Explain what you think and feel.
- Respect differences in opinion – the world would be a boring place if everyone thought the same.
- Share your life experiences and knowledge.

By the end of their research and discussions each member of the group should be clear on the issues facing their target region and should start to form their malaria elimination strategy by completing the group worksheet.

Questions for group discussion:

Encourage the groups to consider the following points when discussing their scenario. These are featured on the scenario sheets and student guidance notes, but it is recommended that you highlight these points before the groups start the exercise.

1. Are there specific sections of the population that should be targeted more than others?

For example, who is most likely to be at risk within the population of your target area? Children, pregnant women, field workers?

2. What are the most appropriate interventions for this region?

Not all interventions are appropriate for all situations. For example, indoor residual spraying is not appropriate if the mosquito vector lives in trees and predominantly bites people outside of buildings.

3. How will issues such as access and poverty impact on your strategy?

Poverty is a major problem in all of these regions. Will people have to pay for the interventions? Will they be subsidised to make them more affordable or will they be distributed for free? Many of the scenarios feature remote communities. How can it be ensured that people within these communities are reached?

4. How will you know if the strategy is having an impact?

Evaluation and monitoring is important to determine whether the programme is working. What are the best ways of monitoring malaria cases in the community? For example, do you use rapid diagnostic tests with anyone showing symptoms of malaria such as a high fever? How are these recorded and who is responsible for recording them? Is there a way of monitoring whether the communities are adopting and using the interventions correctly?

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5. What is the mix of *Plasmodium* species in this area and will this affect the type of drugs prescribed?

It is important to stress that the species of *Plasmodium* will determine the type of treatment patients are given. For example, *Plasmodium vivax* can be treated with primaquine to kill dormant sporozoites in the liver. However this treatment is not suitable against *Plasmodium falciparum* because this species does not form dormant parasites that remain in the liver. Another example is that chloroquine resistant *Plasmodium falciparum* cannot be treated with chloroquine so alternative drugs need to be found.

6. How will the group communicate their strategy to the communities involved?

For a malaria programme to be successful, you need to gain the acceptance and understanding of the communities targeted by the programme. What is the best way to communicate the importance of malaria prevention to these communities? It is important to bear in mind some rural communities have only oral languages and may not be able to read and write. Communication strategies need to overcome these challenges.

Also consider whether or not to involve the community in the programme. For example, could members of the community be trained to continue the programme and train others once the programme is up and running?

Why isn't there a budget for the programme?

This exercise does not include a budget for the scenarios as intervention costs can vary widely from country to country and the students may become too focused on what things cost rather than the impact of the initiative itself. By encouraging the students to select just three initiatives they are being prevented from choosing all available options and encouraged to focus on what is likely to have the biggest impact and where their priorities should be.

If you feel a budget is necessary, you can create your own hypothetical costs for the initiatives.

Step 4: Feeding back the results

All groups should present their malaria elimination strategy for the region they've been given. Encourage the students to explain and discuss why they chose some strategies over others. You can prompt them with questions such as:

- What are the main advantages of choosing method A over method B?
- Are there any limitations to your initiative and how could they be overcome?
- Was it difficult to choose just three initiatives?
- Why did you prioritise those three particular initiatives?
- Of the initiatives you designed which is likely to deliver results first?
- Were there any methods available to you that you thought were not appropriate or feasible?

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Record the answers from all of the groups on a flipchart or whiteboard using a table similar to the one below:

	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6
Initiative 1						
Initiative 2						
Initiative 3						

You could add an element of competition by getting all students to vote for the best malaria elimination strategy at the end of the presentations. A prize can be awarded to the team with the most votes.

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Supporting information for teachers

The information below can be used as suggested prevention initiatives for the malaria programme management scenarios. You will see that there are more than three initiatives featured under the strategy sections. This is to provide material for you, the teacher/facilitator, to encourage discussion but also to demonstrate that there are a range of potential initiatives for the scenario which could be introduced and not just three prescribed options. This aims to demonstrate the challenges of managing malaria in different countries. One size almost certainly doesn't fit all and different approaches are needed to meet the specific needs of the affected communities.

Scenario 1: Border provinces, Cambodia

Who is most at risk?

- Workers who sleep out in the forest camps at night, for example forest workers, military personnel and farmers.
- Pregnant women and children living in remote forest communities.



Where are the problem areas?

- **Forest camps:** workers will sleep out in the forest while away at these camps placing themselves at risk from mosquito populations living near the lake and other wetland areas.
- **Remote communities:** these communities are surrounded by forest and are far away from public health facilities.
- **Farming communities:** these communities are established around agricultural areas such as paddy fields which are ideal breeding grounds for mosquitoes as they are flooded for most of the year.

What are the main challenges in this region?

- **Limited bed net use:** some members of the community use bed nets, however the workers do not when working away from home. These people are potential reservoirs for malaria parasites which can infect other members of the community.
- **Drug resistant parasites:** multi-drug resistant strains of *Plasmodium falciparum* limit your choice of anti-malarial drugs which can lead to more complications and fatalities as the drugs used can be less effective.
- **Multiple vectors:** there are multiple vectors in the region; this means it will be difficult to target all vectors with the same control practices as they exhibit different breeding and feeding habits.
- **Remote communities:** a lot of the villages are very remote and surrounded by forest which limits access to health facilities. The communities may also be inaccessible during the rainy season.

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Strategies appropriate to this region

Initiative 1: Bed net distribution

Mosquito bites are the major issues here. If you can prevent people from being bitten at night this will help to minimise transmission. This initiative could involve:

- Deploying bed nets for any workers who have to stay out in forested areas over night. This can include forestry workers, farmers and military personnel.
- Supplying villages in close proximity to forested areas with long lasting insecticide-treated bed nets. First priority would be for families with young children.
- Training community members on how to educate the villagers in the use of a bed net, when to use it and why. This will ensure knowledge is passed on and the project is sustainable.

Initiative 2: Travelling health clinics

One of the other issues in this region is distance to healthcare facilities. Cases can be reduced and fatalities avoided if rural communities can have regular access to healthcare practitioners and malaria treatments. This initiative could involve:

- Introducing travelling clinics to ensure that remote communities have regular contact with healthcare practitioners.
- Providing antenatal services within travelling clinics to monitor pregnancies and supply pregnant women with at least two doses of intermittent malaria treatments to treat and prevent malaria infections.
- Training community members as village malaria workers (VWMs) who are able to diagnose and treat cases of malaria.
- Buying drugs such as artemisinin combination therapies which will be more effective against drug resistant strains of *Plasmodium falciparum*.

Initiative 3: Drug resistance prevention strategy

Resistance to anti-malarial drugs is a real problem facing many malaria endemic areas of the world. It is therefore important to monitor any new cases of malaria in areas which were previously free from drug resistant parasites. The Cambodia/Thailand borders are already reporting the first cases of resistance to artesunate, an artemisinin-based therapy. This could cause major problems if this continues to spread and could reduce the effectiveness of combination therapies. The drug resistance prevention initiative could involve:

- Organising and implementing the removal and banning of substandard drugs and artemisinin monotherapies from the marketplace to reduce the opportunity for further drug resistance to emerge.
- Working with medical professionals and malaria researchers to track the emergence of drug resistance by investigating cases where artemisinin therapies have taken longer or failed to treat patients with malaria.

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Initiative 4: Environmental management and monitoring

Managing the land and surrounding environment in malaria endemic communities can help to reduce or even eliminate mosquito populations by making the environment unsuitable for them. For example, increasing the flow of water in some areas will reduce the opportunity for mosquitoes to lay their eggs and therefore is likely to reduce the mosquito population. An environmental management strategy could involve:

- Managing the paddy fields to increase the flow of water so they are not suitable breeding grounds for mosquitoes.
- Managing the land in villages to encourage flow of water during the rainy season to prevent the establishment of mosquito breeding sites in shallow pools of water.
- Training farmers and land owners to identify areas that are prone to forming shallow pools and provide training on how to prevent flooding such as channelling water so that it drains away.

Initiative 5: Larvae control programme

Targeting the breeding grounds of the mosquito and destroying the larvae can significantly disrupt the lifecycle of the vector and reduce or eliminate a mosquito population. A larvae control strategy could involve:

- Training farmers to identify mosquito breeding sites on their land and use larvicides to kill the mosquito larvae.
- Introducing native larvivorous fish into paddy fields and community water supplies. These will eat any larvae that hatch in the water supply. The fish can be an edible species providing an additional food supply and/or income for the community.

Initiative 6: Community education programme

Education is an important means of communicating with a community. It can take many different forms from folk theatre to lessons in schools. This initiative could target adults and children by:

- Organising folk theatre events to educate rural communities about malaria.
- Establishing a school education programme where children and their carers are taught about malaria.
- Holding village meetings where education programmes can be presented and community members can get involved.

What initiatives may not be appropriate or effective in this area?

Chemical insecticide use

Chemical insecticides present a dilemma as they are effective at eliminating localised mosquito populations but may have a wider impact on the ecology and biodiversity of the surrounding areas. Spraying farmland with insecticides such as pyrethroid could also lead to the development of mosquitoes that are resistant to insecticides which would reduce the effectiveness of the insecticide and bed nets that have been treated with it.

Indoor residual spraying

Indoor residual spraying would not be appropriate as the mosquitoes in these areas are predominantly exophagic, living and feeding in forested areas.

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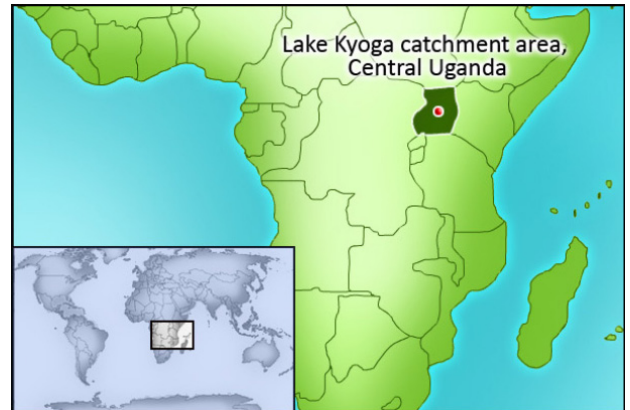
Scenario 2: Lake Kyoga, Uganda

Who is most at risk?

- Pregnant women and children living in rural communities.
- Poorest members of the community.

Where are the problem areas?

- **Rural communities:** these include communities living near Lake Kyoga and other wetland areas as well as those living near agricultural areas, particularly paddy fields.



What are the main challenges in this region?

- **Wetland location:** the catchment area is dominated by a large wetland ecosystem that is an ideal breeding ground for mosquitoes. A lot of communities are near to areas of standing water, either natural or man-made (e.g. paddy fields).
- **Remote rural location:** many of these communities are far away from major towns and cities and therefore have limited access to healthcare provision.
- **Too many mosquitoes:** there is a big mosquito problem in this area -over 1,500 bites per person per year!
- **Poverty:** poverty is a major issue for the majority of the communities in this region. Many cannot afford drugs or bed nets.

Initiatives appropriate to this area

Initiative 1: Bed net distribution

Mosquito bites are the major issue here. If you prevent people from being bitten at night this will help to minimise malaria transmission. This initiative could involve:

- Deploying long lasting insecticide-treated bed nets for free to every home in the target area. The distribution of nets will be supported with training on how to use them.
- Training community members on how to educate others on the correct use of a bed net, when to use it and why. This ensures that the knowledge can be passed on through the community once the initial project has finished.

Initiative 2: Indoor residual spraying of insecticides

The disease vector, *Anopheles gambiae*, is endophagic, i.e. it feeds and rests indoors. As a consequence buildings can be targeted with an indoor residual spraying programme using DDT. This initiative could:

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- Fund indoor residual spraying treatments every six to twelve months in the communities with the highest number of malaria cases. In the worst affected villages every house or community dwelling should be treated.

Initiative 3: Larvae control programme

Targeting the breeding grounds of the mosquito and destroying the larvae can significantly disrupt the lifecycle of the vector and reduce or eliminate a local mosquito population. A larvae control strategy could involve:

- Introducing larvivorous fish such as tilapia to pools and wetlands close to communities. If there are wells or water tanks in the village, fish can also be introduced into them as well. Tilapia are native to Africa so would not be classed as an invasive, foreign species.
- Establishing tilapia fisheries in communities to reduce mosquito populations but also supply additional income for some of the poorer communities.
- Training farmers to identify mosquito breeding grounds on agricultural land and targeting them with biological larvicides.

Initiative 4: Environmental management and monitoring

Managing the land and surrounding environment in malaria endemic communities can help to reduce or even eliminate mosquito populations by making the environment unsuitable for them. For example, increasing the flow of water in some areas will reduce the opportunity for mosquitoes to lay their eggs and therefore is likely to reduce the population. An environmental management strategy could involve:

- Managing the paddy fields to increase the flow and circulation of water so they are not suitable breeding grounds for mosquitoes.
- Managing the land in villages to encourage the flow of water during the rainy season to prevent the formation of shallow pools of water which could be used as mosquito breeding sites.
- Removal of vegetation such as weeds and water hyacinths to increase the flow of water in natural channels of water.
- Draining some areas of wetlands near to communities where there is a high incidence of malaria.

Initiative 5: Travelling health clinics

One of the other key issues in this region is distance to health facilities. The number of cases of malaria can be reduced and deaths avoided if rural communities can have regular access to healthcare practitioners and malaria treatments. This initiative could involve:

- Introducing travelling clinics to ensure the most remote communities have regular contact with healthcare practitioners.
- Providing antenatal services to monitor pregnancies and to supply pregnant women with at least two doses of intermittent malaria treatments to treat and prevent malaria infections.
- Training community members as village malaria workers who are able to diagnose and treat cases of malaria.

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- Purchasing drugs such as artemisinin combination therapies as these will be more effective against the *Plasmodium falciparum* parasite and will be less likely to lead to the emergence of drug resistant parasites.

Initiative 6: Community education programme

Education is an important means of communicating with a community. It can take many different forms from folk theatre to lessons in schools. This initiative could target adults and children by:

- Organising folk theatre events to educate rural communities about malaria.
- Establishing a school education programme where children and their carers are taught about malaria.
- Holding village meetings where education programmes can be presented and community members can get involved.

What initiatives may not be appropriate or effective in this area?

Chemical insecticides or larvicides

A wide range of approaches could work in this particular area as shown above, however there is one key factor for this scenario that may limit the use of chemical-based interventions; the natural environment. Lake Kyoga is a large natural resource, home to hundreds of different species both above and below the water. Strategies that impact on the natural environment could have implications for the local communities. For example, the lake is a source of food and income through an active fishing industry. The use of chemical insecticides or larvicides in this area could impact on other species in the ecosystem by eliminating a food source for fish species or polluting the local environment. Both of these could potentially lead to a reduction in fish stocks. Therefore any strategies that involve toxic chemicals must be carefully considered for their impact on the natural environment.

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Scenario 3: Dar es Salaam, Tanzania

Who is most at risk?

- Pregnant women and children as these are the groups with least immunity.
- People living in unplanned settlements, e.g. squatter settlements and shanty towns.
- People living in poverty.



Where are the problem areas?

- **The unplanned settlements:** these have poor structure, drainage and sanitation. The lack of a proper drainage system leads to the formation of pools of standing water that are ideal mosquito breeding grounds. People who inhabit these areas also live in extreme poverty and have limited access to the healthcare system.

What are the main challenges in this region?

- **Unplanned settlements:** Dar es Salaam has one of the fastest growing populations, which has resulted in unplanned settlements being built on the outskirts of the city. These settlements are often regarded as illegal settlements so receive little government support.
- **Poor waste collection:** this leads to the accumulation of debris in the city's drainage system which reduces water flow creating breeding grounds for mosquitoes.
- **Poverty:** many people in this region cannot afford drugs or bed nets and are unable to access public healthcare services.

Initiatives appropriate to this area

Initiative 1: Bed net distribution

People living in the settlement areas have little protection from mosquitoes in their homes. They do not have mesh screens to cover their windows to prevent mosquitoes getting in. The following initiative will work towards minimising the risk of mosquito bites and will involve:

- Deploying long lasting insecticide-treated bed nets for free to every home with children in the target area including slums. The distribution of nets will be supported with training on how to use them.

Initiative 2: Indoor residual spraying of insecticides

Buildings can be targeted with an indoor residual spraying programme with DDT because the predominant vector of malaria in this area is *Anopheles gambiae* which is endophagic – it feeds and rests indoors. An indoor residual spraying programme could:

- Fund indoor residual spraying for problem areas in the city including unplanned settlements.

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Initiative 3: Larvae control programme

Targeting the breeding grounds of the mosquito and destroying the larvae can significantly disrupt the lifecycle of the vector and reduce or eliminate a local mosquito population. In a city environment, drains provide ideal breeding habitats for mosquitoes, especially if the water is slow flowing because the drain is blocked by rubbish. A larvae control strategy in the city could involve:

- Treating drains and areas prone to flooding with biological or chemical larvicides.
- Establishing a community drain clearance programme where members of the community are trained and responsible for removing debris from drains. This will increase the flow of water and reduce the number of potential mosquito breeding sites.

Initiative 4: Travelling health clinics

One of the major issues, particularly facing settlement dwellers, is limited access to healthcare services. Entry into the public health system requires proof of residence and settlements are not classed as official residences. Some people cannot access healthcare facilities as they have no transport. An outreach health initiative could include:

- Introducing outreach clinics that will travel to the informal settlements where they can diagnose and treat malaria cases.
- Providing antenatal services to monitor pregnancies and to supply pregnant women with at least two doses of intermittent malaria treatments to treat and prevent malaria infections.
- Buying drugs such as artemisinin combination therapies as these will be more effective against the *Plasmodium falciparum* parasite and will be less likely to lead to the emergence of drug resistant parasites. Drugs will be available through public health facilities in the city and outreach clinics.

Initiative 5: Community education programme

Education is an important means of communicating with a community. It can take many different forms from street theatre to lessons in schools. This initiative could target adults and children by:

- Organising street theatre events to educate communities within the city about malaria.
- Establishing an education programme where children are taught about malaria in school.

Initiative 6: Drug resistance prevention strategy

Resistance to anti-malarial drugs is a real problem facing many malaria endemic areas of the world. It is therefore important to monitor any new cases of malaria in areas which were previously free from drug resistant parasites. Artemisinin combination therapies are, at present, very effective at treating *Plasmodium falciparum* infections. However the use of artemisinin monotherapies or substandard drugs can create an environment where drug resistance can develop in the parasite. This could cause major problems if this continues to spread and could make combination therapies less effective. A drug resistance prevention initiative could:

- Organise and implement the removal and banning of substandard drugs and artemisinin monotherapies from the marketplace to reduce the opportunity for further drug resistance to emerge.
- Work with medical professionals and malaria researchers to monitor the effectiveness of anti-malarial

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drugs. This will act as a warning system for the presence of drug resistant strains of *Plasmodium falciparum*.

What initiatives may not be appropriate or effective in this area?

Establishing fisheries for larvivorous fish

Larvae control in a city is possible through the use of larvicides but the use of natural predation on a large scale would not be practical. The main problems would be the lack of suitable locations and facilities in an urban area and the expense of set up costs. As there are no large bodies of freshwater, such as lakes, in the area this option would be unfeasible.

It may be possible to introduce small fish species into family or community water supplies like water tanks. However, the community may not be comfortable sharing their drinking water with fish and this approach is unlikely to be sustainable as the fish would have to be replaced when they died.

Scenario 4: Amazonas, Brazil

Who is most at risk?

- Pregnant women and children in rainforest communities.
- Workers in rainforest areas, e.g. forest camps and agricultural land.
- Immigrant workers moving to the region.
- People living in new unplanned settlements on the outskirts of the cities.



Where are the problem areas?

- **The unplanned settlements:** these have poor structure, drainage and sanitation. The lack of a proper drainage system leads to the formation of pools of standing water that are ideal mosquito breeding grounds. People who inhabit these areas live in extreme poverty and are unable to access the healthcare system.
- **Rainforest communities:** these areas are remote rural communities that are often a long distance from any public healthcare facilities.

What are the main challenges in this region?

- **Large rainforest cover:** rainforest covers 90% of this region. This presents challenges with interventions that target the control of the mosquito population as chemicals may impact on the complex ecosystems present in the forests.
- **Vector behaviour:** the main malaria vector in this region is *Anopheles darlingi*. This mosquito lives in forests, feeds outdoors and is most active at dusk and early evening. This means that people working or

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living near forested areas are more likely to be bitten by mosquitoes and be infected with the malaria parasite.

- **Flooding:** some areas are permanently or regularly flooded providing perfect mosquito breeding habitats.
- **Rural communities:** some of the rainforest communities are very remote and do not have easy, regular access to public healthcare facilities.
- **Unplanned settlements:** Manaus has a fast growing population, which has resulted in unplanned settlements being built on the city fringes. These settlements do not have adequate drainage or sanitation and are regarded as illegal so receive little government support. New illegal settlements are also being established in the forests. Unplanned settlements make population monitoring very difficult.
- **Immigration:** there is a lot of migration to the area that introduces people into the population who do not have immunity to the local malaria parasites. These people are more likely to develop severe malaria.
- **Multiple *Plasmodium* species:** although *Plasmodium vivax* is the predominant species of parasite, there is a mix of *Plasmodium* species in the area.

Initiatives appropriate to this area

Initiative 1: Insect repellent distribution

Insect repellents provide a chemical barrier from the mosquito and can be worn during the day and at dusk to minimise mosquito bites. An insect repellent distribution programme could provide protection to people in areas where bed nets are not effective due to mosquito feeding behaviours. Such a strategy could include:

- Supplying vulnerable populations, such as forest workers, agricultural workers and forest communities, with effective insect repellent as they are active outside and exposed to mosquitoes.
- Funding research into mosquito repellents that could be developed from natural local resources such as plants. This could lead to a sustainable and renewable source of repellent that could be produced by local community members.

Initiative 2: Larvae control programme

Targeting the breeding grounds of the mosquito and destroying the larvae can significantly disrupt the lifecycle of the vector and reduce or eliminate a local mosquito population. In an urban environment, drains provide ideal breeding habitats for mosquitoes, especially if the water is slow flowing because the drain is blocked by rubbish. A larvae control strategy in the city could involve:

- Using biological larvicides in areas prone to flooding in settlements and the city. Depending on the environmental impact, these larvicides may also be used in some of the rainforest communities.
- Housing small larvivorous fish in community water supplies such as water tanks.
- Utilizing abandoned fishery tanks to house larvivorous fish to prevent the tanks being used by mosquitoes as breeding sites.

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Initiative 3: Environmental management

Managing the land and surrounding environment in malaria endemic areas can help to reduce or even eliminate mosquito populations by making the environment unsuitable for them. For example, increasing the flow of water in some areas will reduce the opportunity for mosquitoes to lay their eggs and is therefore likely to reduce the population. An environmental management strategy could involve:

- Removing vegetation from streams and rivers near communities so that the flow of water is increased to make it less suitable for mosquitoes to lay their eggs.
- Training community members in the best ways to manage their local environment to reduce the formation of potential mosquito breeding sites.
- Making modifications to areas where flooding occurs to reduce the risk of flooding, particularly in areas close to established human populations. This needs to be carefully considered to evaluate the impact on the environment and native species living in these areas.

Initiative 4: Travelling health clinics

One of the major issues, particularly facing settlement dwellers, is limited access to healthcare services. Entry into most public healthcare systems requires proof of residence and settlements are not classed as official residences. Some people are unable to physically reach facilities as they do not have access to transport. This initiative could involve:

- Introducing outreach clinics that will travel to the informal settlements where they can diagnose and treat malaria cases.
- Introducing clinics that will travel to the more remote rainforest communities where they can diagnose and treat malaria cases.
- Providing antenatal services to monitor pregnancies and supply pregnant women with at least two doses of intermittent malaria treatments to treat and prevent malaria infections.
- Training village malaria workers in rainforest communities who will be able to diagnose and treat cases of malaria to reduce the need to travel to healthcare facilities.
- Buying drugs such as chloroquine and primaquine as these will be most effective against *Plasmodium vivax*. Drugs will be available through public healthcare facilities in the city and the outreach clinics that travel to urban settlements and remote rainforest communities. The use of artemisinin combination therapies should be considered for cases of malaria caused by *Plasmodium falciparum*.

Initiative 5: Community education programmes

Education is an important means of communicating with a community. It can take many different forms from street theatre to lessons in schools. This initiative could target adults and children by:

- Organising street theatre events to educate communities in the city about malaria.
- Establishing an education programme where children are taught about malaria in school.
- Travelling to the more remote communities to raise awareness of malaria and how it can be prevented.

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Initiative 6: Bed net distribution

People living in forested areas have little protection from mosquitoes, especially if they sleep outside. The following initiative will work towards minimising the risk of being bitten. This could also be used in conjunction with an insect repellent programme. This programme would:

- Deploy long lasting insecticide-treated bed nets for free to people in the high risk communities, i.e. remote forest communities and those working in forest areas. The distribution of bed nets will be supported with training on how to use them.

What initiatives may not be appropriate or effective in this area?

Chemical insecticide use

Chemical insecticides present a problem as they are effective at killing and eliminating local mosquito populations but may have an impact on the ecology and biodiversity of the surrounding areas. Spraying farmland with insecticides such as pyrethroid could lead to the emergence of insecticide resistant mosquitoes. This would render the insecticide ineffective and reduce the effectiveness of insecticide treated bed nets.

Indoor residual spraying (IRS) would not be appropriate as the mosquitoes in these areas only live and feed in forested areas. DDT, which is recommended for indoor residual spraying, is chemically very stable and can therefore remain on surfaces for months. This in turn allows the chemical to build up in an ecosystem and be passed along food chains. In an environment of high biodiversity this has the potential to cause major ecological problems.

Bed nets – to use or not to use?

In this scenario, bed nets present an interesting dilemma. They would provide only limited protection against mosquito bites because the major vector, *Anopheles darlingi*, lives and feeds in forested areas. It is, therefore, unlikely to reside and feed inside buildings inhabited by humans. It also predominantly feeds in the early evening before people go to bed.

The use of bed nets in conjunction with insect repellents may be effective as it provides protection before and after going to bed. Bed nets alone would be much less effective.

Before funding a large (and potentially expensive) bed net distribution programme research trials should be carried out in high risk groups to determine whether it is a successful prevention method. If bed nets do prove successful the programme could then be extended to other problem areas.

Evaluating malaria elimination programmes

Evaluation of programmes is essential to be able to identify whether your strategy is successful and if it can be improved. A malaria elimination programme could be evaluated by:

- Using existing data on the number of cases of malaria diagnosed and treated before the implementation of your strategy. This will provide baseline figures from which you can assess if your strategies have had an impact.
- Establishing a reporting system that monitors the number of malaria cases diagnosed and treated in the area after the elimination programmes have been introduced. The reporting system should aim to include people treated through public healthcare centres and outreach clinics. This can be used to

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- identify if the number of cases is decreasing following the implementation of the initiatives.
- Establishing a system of community malaria workers or researchers to monitor the use of bed nets, i.e. how many people are using them, where they are using them and how often.
- Monitoring mosquito populations in the region to see if they have increased or decreased as a result of your strategy.
- Monitoring the number of deaths from malaria and comparing these with previous data to see if numbers are decreasing.

Communicating malaria elimination strategies to the local community

The first step in establishing a programme within a community is to gain their trust and support. This is best achieved by contacting the community leaders who have the most influence and can set up village or community meetings.

Most of the initiatives are specifically designed to actively involve the community so they have a sense of ownership towards the scheme. They also involve training community members to carry out specific roles and tasks to ensure that the project is sustainable and can be continued once the trainers have left.

Communication often needs to be predominantly verbal as not all members of the community will be able to read and write so this should also be factored into a communication strategy.

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Post-activity discussion points

What makes a successful malaria eradication programme?

Malaria burden has been successfully reduced in regions of South America (Brazil), Africa (Eritrea), South Asia (India) and South East Asia (Vietnam). These programmes shared a number of factors that ensured they were successful including:

- a sound, targeted approach
- sufficient finances
- strong healthcare infrastructure
- technical support from partners
- government support.

Below are a number of factors that can influence the success of a malaria control programme:

The “combination” approach

Successful malaria programmes use a combination of control methods coupling techniques such as indoor residual spraying and insecticide-treated bed nets with environmental management practices and rapid diagnosis and treatment of malaria cases. These targeted programmes significantly reduced the number of deaths from malaria in these regions.

Target high risk areas

Most successful projects focus on initially targeting the areas where malaria burden is highest. This approach ensures that those who are most vulnerable to malaria are protected, reducing the number of infections and deaths. Once the number of infections starts to decrease within a population, there is a greater chance of eliminating malaria from that local area.

Keeping it local

Decentralisation is another key to programme success. Moving the responsibility away from central government and handing it to local governments can stimulate a sense of ownership of malaria control programmes. The local governments are responsible for the management and prioritisation of the resources for their specific regions following the country's national strategy guidelines.

Community involvement is also essential. If community members feel part of a project they are more likely to participate and maintain good practice. A lot of new initiatives are encouraging local communities to take an active role in their malaria programmes. For example, in Cambodia they have introduced malaria village worker schemes where community members are trained to diagnose and treat malaria cases. In parts of Dar es Salaam, communities have been made responsible for regular drain clearance and larviciding to reduce mosquito breeding sites.

Financing

Malaria control programmes can be expensive. Elimination programmes are more likely to be successful if they are sufficiently financed. Funding and support is usually received from national governments however the amount of government funding varies widely by region and by country. Current national funding covers only a fraction of what is needed for the implementation of malaria control programmes, especially in high burden countries. This is particularly true in Africa, where government budgets on average represent only

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18% of total malaria funding. In these situations additional funding is required. Additional funding can come from international organisations such as the World Bank, the US President's Malaria Initiative and the Global Fund to Fight Malaria. Large charities such as the Bill and Melinda Gates Foundation also provide significant financial support to projects. In 2010, the UK government pledged to increase UK aid spending on malaria to £500 million per year by 2014.

Technical support and partnerships

Many successful malaria programmes are the result of partnerships between national malaria programmes and partner agencies such as the World Health Organization or the United States Agency for International Development (USAID). These organisations provide training and support that ensures a country's malaria eradication projects are delivering the right resources to problem areas. They also ensure that programmes are sustainable.

Good public health infrastructure

A good malaria programme has the means to quickly diagnose and treat cases of malaria. This requires a stable and developed public healthcare system. If a programme is to succeed it needs to have a means of accessing, diagnosing and treating patients quickly and effectively. If there is a weak healthcare infrastructure the programme will struggle to succeed. This is strongly linked to other factors such as financing, political stability and government support.

Political stability

Many of the countries with successful malaria programmes have stable governments and are experiencing economic growth. This allows them to focus on improving public healthcare infrastructure and improving living conditions for their citizens as well as delivering malaria control programmes. However many of the countries with high malaria burdens are politically unstable and are trapped in a cycle of civil unrest and violence, making it almost impossible to tackle the problem of malaria.

The Central African Republic has experienced decades of political violence due to clashes between rebel groups and government forces. Malaria accounts for 13% of all deaths in this country. Violence and political instability make it very difficult to manage and maintain any form of malaria control programme.

Further reading

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