

MALARIA IN YEMEN: NEEDS ASSESSMENT

2017



65
YEARS

International Organization for Migration
The UN Migration Agency

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ACRONYMS

ACT	Artemisinin-based Combination Treatment
AQAP	Al Qaida in the Arabian Peninsula
CL	Cutaneous Leishmaniasis
DDT	Dichloro-diphenyl-trichloroethane
DH	District Health
GBV	Gender-based Violence
HC	Health Centre
HeRAMS	Health Resources Availability Mapping System
HF	Health Facility
HU	Health Unit
IDPs	Internally Displaced People
IEC	Information Education and Communication
IM	Intra-muscular
INGO	International non-governmental organization
IPC	Integrated Phase Classification
IRS	Indoor Residual Spraying
IS	Islamic State
ITN	Insecticide Treated Net
IV	Intra-venous
IVM	Integrated Vector Management
LF	Lymphatic Filariasis
LLIN	Long-lasting Insecticide treated Nets
MAM	Moderate Acute Malnutrition
mASL	Metres above Sea Level
MDA	Mass Drug Administration
MDA	Mass Drug Administration
MIS	Malaria Indicator Survey
MPR	Malaria Programme Review
NFI	Non-food Item
NGO	Non-governmental organization
NMCEs	National Malaria Control and Elimination Strategy
NTD	Neglected Tropical Disease
OTP	Outpatient Therapeutic Programme
PCR	Polymerase Chain Reaction
Pf	<i>P. falciparum</i>
PLW	Pregnant and Lactating Women
RDT	Rapid Diagnostic Test
SAM	Severe Acute Malnutrition
SFP	Supplementary Feeding Programme
TFPM	Task-force on Population Movement
TSFP	Targeted Supplementary Feeding Programme
VL	Visceral Leishmaniasis
WASH	Water Sanitation and Hygiene
WMR	World Malaria Report

Organizations	
ACF	Action Contre la Faim
ADO	Abs Development Organisation
ADRA	Adventist Development and Relief Agency
AFHD	Alraeeda Foundation for Human Development
AISDC	Al Atta Institution for Social Development and Charity
AOBWC	Alaman Organization for Blind Women Care
CSSW	Charitable Society for Social Welfare
DEC	Disasters Emergency Committee
DRC	Danish Refugee Council
GF	Global Fund
GIZ	Gesundheits-Informations-Zentrum
GWQ	Generations without Qat
HADO	Humanitarian Aid and Development Organisation
ICRC	International Committee of the Red Cross
IMC	International Medical Corps
IOM	International Organization for Migration
IRY	International Relief Yemen
MC	Mercy Corps
MMFY	Medical Mercy Foundation Yemen
MoPHP	Ministry of Public Health and Population
MSIY	Marie Stopes International Yemen
NMCP	National Malaria Control Programme
NRC	Norwegian Refugee Council
PA	Partner Aid
PU-AMI	Première Urgence - Aide Médicale Internationale
QC	Qatar Charity
QRCS	Qatar Red Crescent Society
RI	Relief International
RLCC	Regional Leishmaniasis Control Clinic
SCI	Save the Children International
SOUL	SOUL for Development
VHI	Vision Hope International
WHO	World Health Organisation
WHO	World Health Organisation
YDN	Yemeni Development Network for NGOs
YFCA	Yemen Family Care Association
ZOA	ZOA Refugee Care

MALARIA IN YEMEN: NEEDS ASSESSMENT

INTRODUCTION

The International Organization for Migration (IOM) has asked the Mentor Initiative (Mentor), a London based international NGO that specializes in integrated vector management in humanitarian emergencies, to finalise an assessment on malaria control in Yemen, with the objective to make recommendations to IOM on how to achieve maximum impact on malaria control with limited financial means. For this, Mentor finalized a first draft in May, followed by a revised version in June that has incorporated most of the feedback that it had received from the different stakeholders (NMCP, WHO and IOM). In order to field-test the recommendations of this report. Two members of the Mentor HQ left for Yemen on the 17 July to talk to the authorities in Yemen, the stakeholders and non-governmental organizations, all with the objective to prepare a final version of the assessment report to be submitted to IOM and via this organization to the main stakeholders (National Malaria Control Program, Ministry of Health, WHO).

The conflict in Yemen has been ongoing and, by most accounts, escalating since March 2015. This has resulted in a complex humanitarian situation

where conflict has exacerbated existing volatilities and vulnerabilities in a country already considered to be insecure. Already the world's seventh most water insecure country, Yemen is now faced with severe challenges associated with deteriorating infrastructure, such as restricted access to and delivery of healthcare, water and sanitation and many other essential services. The latest UNOCHA report states that 18.8 million of Yemen's population (27.4 million) are in need of humanitarian assistance, 10.3 million of those being acutely in need¹. Whilst conflict related deaths have been estimated at 7,100 and injuries at 44,000 (March 2015 and November 2016)¹, these numbers fail to adequately depict the severity of the situation as information is primarily collated from health facilities. Between 274 and 600 health facilities are reported to have been destroyed or damaged, 31 health workers injured and a further 13 killed over the past 24 months, calling into question the accuracy of data collected from these strategic points¹. Patient consultations have dropped by as much as 20% at health facilities and underreporting of health issues, both directly and indirectly related to conflict, is therefore likely to be widespread². 14.8 million people lack access to basic healthcare and 8.8 million are living in severely underserved areas, representing a 76% increase since before the conflict began¹.

¹ https://docs.unocha.org/sites/dms/Yemen/YEMEN%202017%20HNO_Final.pdf

² http://reliefweb.int/sites/reliefweb.int/files/resources/2016_HNO_English_%20FINAL.pdf

MALARIA IN YEMEN

Malaria has historically been a major public health concern in Yemen, noted to be the country of highest prevalence in the Eastern Mediterranean Region. Malaria is known to be present in all areas <2000mASL, primarily of the parasitic form *P. falciparum* with *P. malariae* and *P. vivax* accounting for the remaining cases. An estimated 60%³ to 78%⁴ of Yemen's population live in malaria risk areas, with roughly 25% located in high risk areas (>1 cases in 1000)⁵, mainly concentrated down

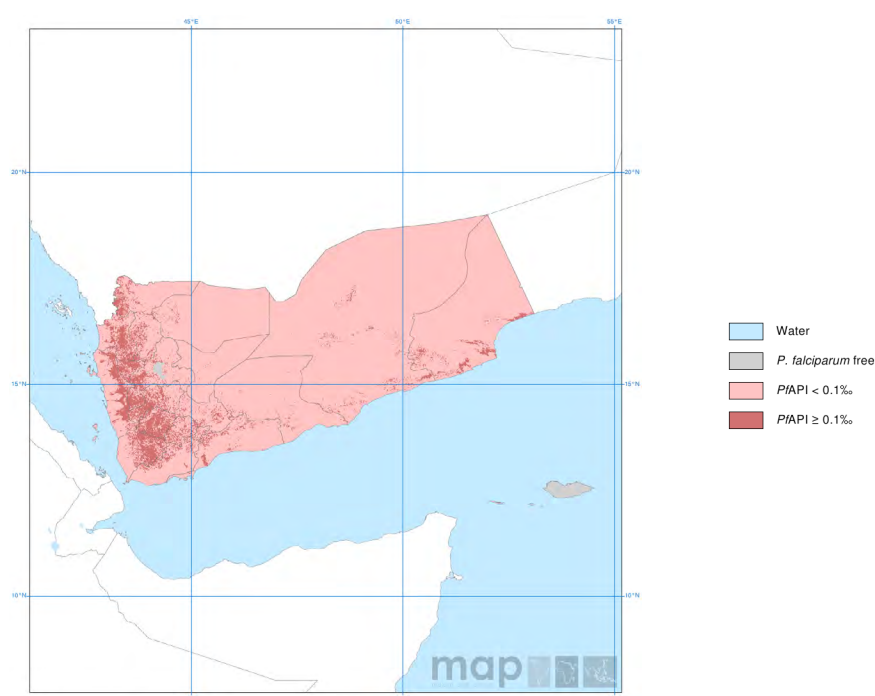
the western side (Tehama Region) of the country (Figure 1, *Malaria Atlas Project Map - P. falciparum malaria transmission in Yemen*⁶). Over 99% of all reported cases (Table 1: *Reported Malaria Cases by Species: 2000-2015*⁷) are caused by *P. falciparum* however studies using PCR to determine species from patients in Yemen indicate that *P. vivax* and *P. malariae* may be understated in national epidemiological surveillance figures⁵.

Table 1: Reported Malaria Cases by Species: 2000–2015

	2000	2005	2010	2011	2012	2013	2014	2015
SUSPECTED	-	629,380	835,018	804,940	891,394	927,821	725,169*	668,024*
P. FALCIPARUM	-	42,627	77,301	59,696	109,504	102,369	86,440*	68,682*
P. VIVAX	-	1,442	966	478	398	408	267	300
OTHER	-	-	2	33	-	0	0	-

**Important note:* Data collectors have not been paid since mid 2014, therefore numbers are likely to be severely underreported in 2014 and 2015.

Figure 1: Map shows historic transmission limits of *P. Falciparum* in Yemen, highlighting areas at risk of high transmission in dark red and lower risk in red⁶



³ <https://parasitesandvectors.biomedcentral.com/articles/10.1186/1756-3305-4-94>

⁴ <http://www.emro.who.int/yem/yemen-news/who-scales-up-response-for-increase-in-malaria-in-yemen.html>

⁵ <http://www.who.int/malaria/publications/world-malaria-report-2015/wmr2015-profiles.pdf>

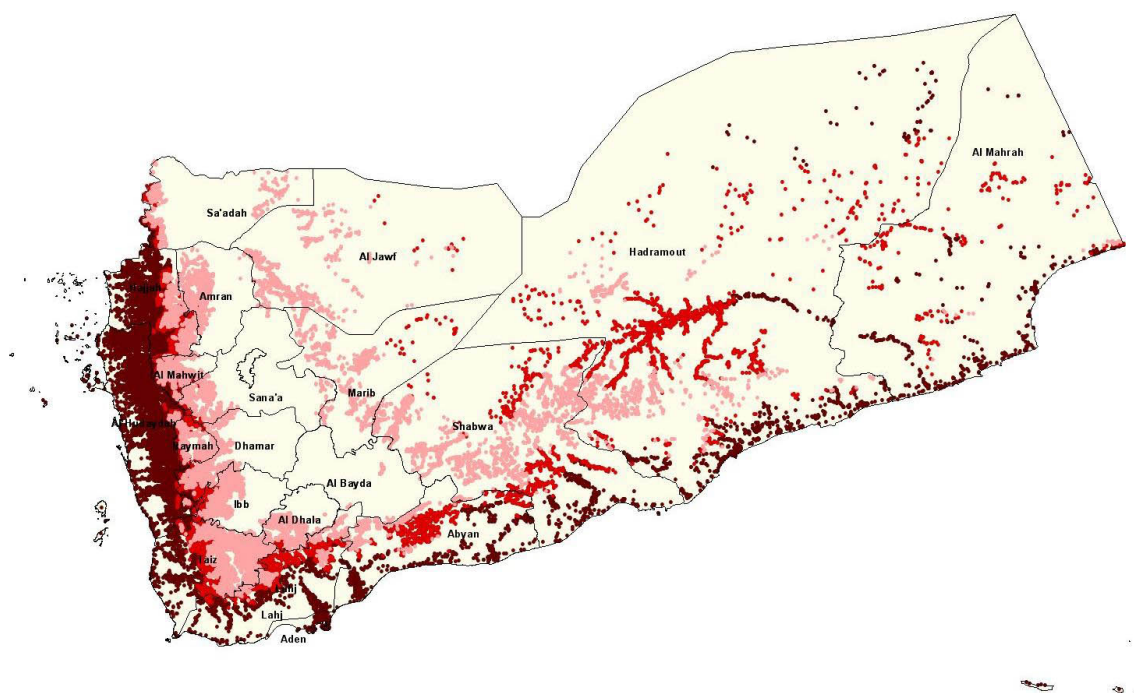
⁶ http://www.map.ox.ac.uk/browse-resources/transmission-limits/Pf_limits/YEM/

⁷ <http://www.who.int/malaria/publications/world-malaria-report-2016/WMR-2016-annexes.pdf>

Figures 1 and 2 demonstrate transmission limits of *P. falciparum* and its prevalence. Figure 1 shows transmission limits, taken as an average over time whilst figure 2 is an updated malaria transmission map that was produced using prevalence data from the Malaria Indicator Survey (MIS) in 2013. The MIS was carried out in March of that year so should be seen as snapshot in time, where high risk malaria areas are at their peak of transmission rates and moderate to low are outside of their seasonal peak. The MIS survey data has limitations, such as failing to fully account for seasonality, but still essentially confirms the general Pf malaria transmission patterns estimated in Figure 1. In addition, Figure 2 is able to add more

specificity and differentiation in terms of which geographic areas experience the greatest burden of disease. The maps both show a concentration of malaria transmission down the western coast, a region known as Tehama. Al Hudaydah, and Hajjah are the two governorates with the greatest areas at high risk of malaria transmission according to the MIS map. Low altitude areas of Sa'ada and Taizz and pockets along the western edges of Al-Mahweet, Raymah and Lahj are also shown to be areas of relatively high risk of malaria transmission. Western edges of Amran, Dhamar and Ibb also are affected by malaria, though appear to cover a smaller area than the other governorates mentioned.

Figure 2: Map to show enumeration areas for Malaria Indicator Survey 2013 for the 3 strata at risk of malaria transmission, corresponds to topography map with areas of highest risk being those along the western coastal areas. (See Annex 1)



The MoPHP Malaria Programme Review (MPR) in 2013 produced another useful map from existing data, presenting hotspots of transmission by district (Figure 3). This clearly demonstrated the pockets of high transmission within the following governorates (see districts in dark red) at that time:

Sa'ada - Al Dhaher

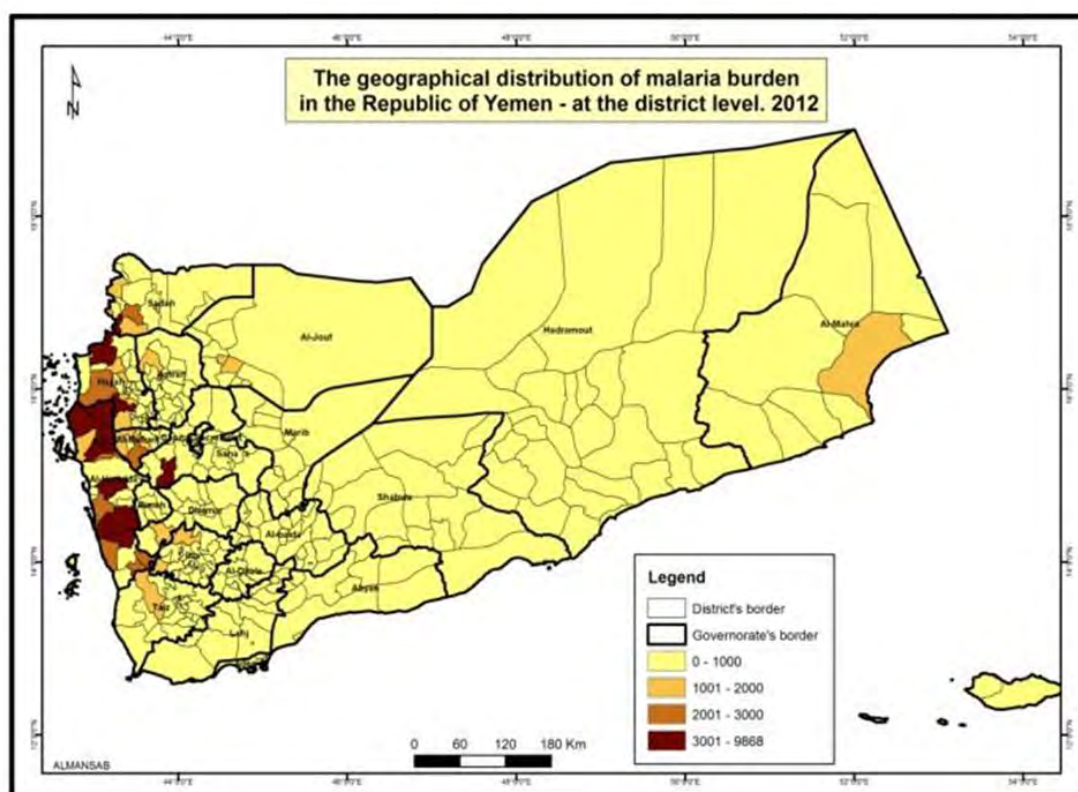
Hajjah - Haradh, Ku'aydinah

Al Hudaydah - Alluheyah, Az Zuhrah, Al Qanawis, Az Zaydiyah, Al Marawi'ah, Bayt Al Faqiah, Zabid

ENVIRONMENTAL RISK FACTORS

Geographical factors that indicate risk of malaria infection, unlike case data itself, remain fairly consistent each year. Mosquito breeding and habitation sites and therefore average annual mosquito vector capacity of different regions, are usually fairly constant geographically. Under

some extraordinary circumstances, the usually geographically constant malaria transmission, tightly linked to preferred breeding and feeding conditions for mosquitoes, can be affected resulting in increased potential of epidemics.



VECTORS FOR MALARIA

Fifteen different species of *Anopheles* mosquito have been identified in Yemen; *An. arabiensis* and *An. culifacies* are primary vectors <600mASL whilst *An. arabiensis* and *An. sergenti* are more prevalent at higher altitudes⁸. Whilst human populations are subject to significant changes

with various events, vector populations are remarkably stable as they are reliant on specific topography and geographical features for survival that are unlikely to change dramatically over time (table 2).

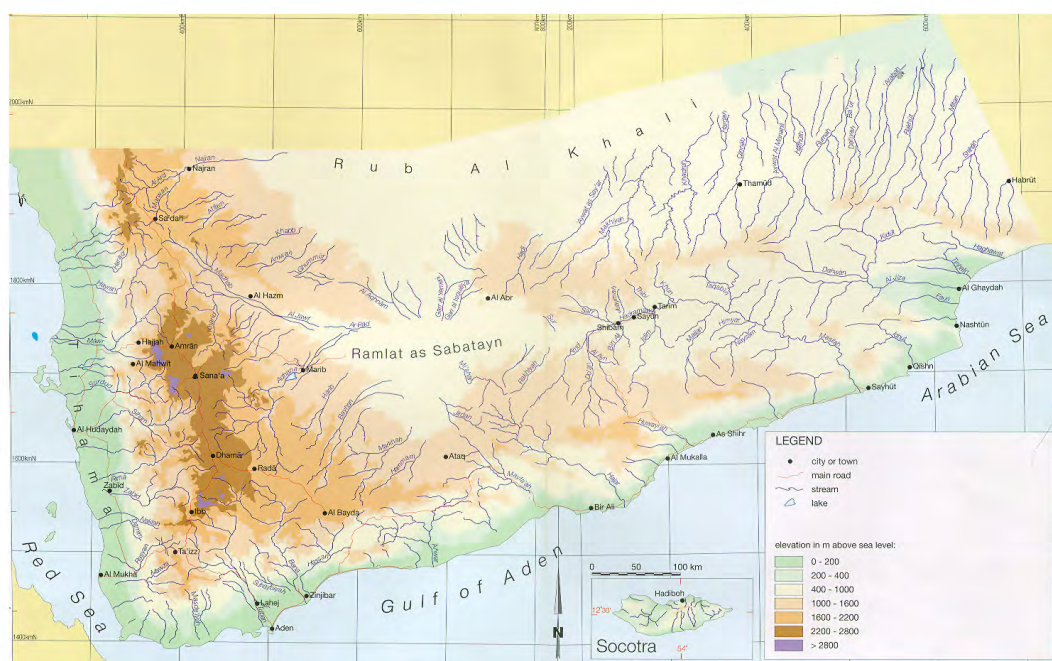
⁸ <https://malariajournal.biomedcentral.com/articles/10.1186/s12936-016-1179-8>

Table 2: Vector Characteristics and Behaviours in Yemen⁶

Species / species complex	Vector status across species' range	Primary environment	Zoophilic / anthropophilic	Endo / exophagic	Endo / exophilic	Biting time
<i>Anopheles (Cellia) arabiensis</i> Patton, 1905	Important vector	Dry savannah, sparse woodland and rice fields	Both	Exophagic / both	Both	Evening / night / dawn
<i>Anopheles (Cellia) sergentii</i> species complex	Variable depending on location	Desert oases, irrigation channels with vegetation or algae and rice fields	Zoophilic / both	data not available	Both	data not available
<i>Anopheles (Cellia) culicifacies</i> species complex	Variable depending on species and location	Forested areas with perennial streams, deforested riverine ecosystems and irrigated areas, plains, hilly and mountainous areas	Zoophilic / both	Both	Endophilic / both	Evening / night

Yemen has a highly variable topography (see figures 4⁹ and 5¹⁰) and climate affecting vector species, seasonality and transmission rates dependent on location¹¹. This geographical interlinking is mainly driven by rainfall and the times of the year the different regions can sustain water sources that provide suitable breeding grounds for the various vectors:

1. 0-600mASL (highest risk) coastal areas transmission season in winter (October/November–April)
2. 601-1000mASL (moderate risk) transmission in winter and a short summer season (May–September)
3. 1001- 2000m (low risk) longer summer season (May–September)
4. >2000 meters and the desert areas is generally considered free from malaria¹¹

Figure 4: Elevation map of Yemen to show variable topography¹⁰

⁹ www.maps-of-the-world.net/maps-of-asia/maps-of-yemen/detailed-elevation-map-of-yemen.jpg

¹⁰ http://media.springernature.com/full/springerstatic/image/art%3A10.1186%2Fs12936-016-1179-8/MediaObjects/12936_2016_1179_Fig1_HTML.jpg

¹¹ www.theglobalfund.org/ProgramDocuments/YEM/ConceptNotes/2014/YEM-M_ConceptNote_0_en/

The multiple vectors present in Yemen have different distributions depending on environmental and behavioural preferences. This becomes significant in considerations around control programmes for malaria, especially when accounting for indoor and outdoor behaviour and preferred biting times.

If particular mosquito species are predominant in an area then control programmes can be tailored accordingly:

One of the most recently published entomological studies for Yemen⁸ confirms historical data on the prevalence of *An. arabiensis*. Data collected in Taizz governorate confirmed 87% malaria vectors found in houses were *An. arabiensis* and 9% *An. Sergenti*, with the remaining being a mix of other

species of relatively little importance (see Figure 6). *An. arabiensis* transmit malaria in both wet and dry seasons, and in Yemen predominantly feed on humans (anthropophilic) but also feed on animals. It is an efficient vector and in this study, it was shown to have an entomological inoculation rate of 1.58 infective bites/person/year. *An. sergentii* were found to feed on cattle (67.3 %) and humans (48.3; 20.7 % mixed both species), but only 14.7 % were found to have been resting within houses, indicating predominantly outdoor biting (exophilic) behaviour. A GIS analysis of geographic and socioeconomic parameters revealed that *An. arabiensis* were found at significantly higher density in houses with televisions, most likely due to the popular evening habit of viewing television collectively in houses with open doors and windows.

Figure 5: Some Examples of Varied Rural Topography Yemen



An. arabiensis is known to bite primarily in the evening and night, both indoors and outdoors. In a number of well-studied African countries, the feeding and resting behaviour of *An. arabiensis* has shown to have changed over recent years, potentially as a result of intensive exposure to mass LLINs or IRS. Changes have resulted in cattle and other animals becoming more important sources of blood, rather than humans, and increased resting in animal shelters. This indicates that this vector is highly adaptable over a short number of years. The last good entomological data from Yemen was gathered in 2004/5 and as such, *An. arabiensis* biting behaviour may now be as important outdoors, as indoors.

In considering both *An. sergentii* and *An. arabiensis*, the main vectors of malaria in Yemen, biting behaviour must be factored into control programme design. It is likely that standard prevention approaches will have less efficacy than in countries where indoor biting vectors predominate and integrated vector management approaches are likely to prove more effective, where feasible to deliver. See the recommendations section of this report.

In areas that experience sharp changes in environmental factors, transmission risk may exceed normal years. Where there is unseasonal rainfall, flooding and sudden escalation in surface water (at times of year when the ambient temperature is at least 19°C or above), and where that remains for a month or more provides the conditions for many new insect breeding sites to be established and consequently, mosquito populations can exponentially expand. This in turn, increases vector capacity and transmission in malaria endemic areas. In partially immune resident populations, such as those living in high transmission (low altitude) areas, this type of environmental event, whilst increasing overall transmission, continues to primarily affect younger children and adults with compromised immune systems, such as pregnant women. If the same environmental events occur in areas of low/moderate transmission areas (where children do not receive adequate numbers of malaria infections each year to ever develop meaningful partial immune protection from severe disease), then these may result in epidemics. It is under such circumstances that all age groups will be at risk of infection and clinical disease. Long term changes in agriculture and urbanization can also impact (to increase or decrease) vector capacity in

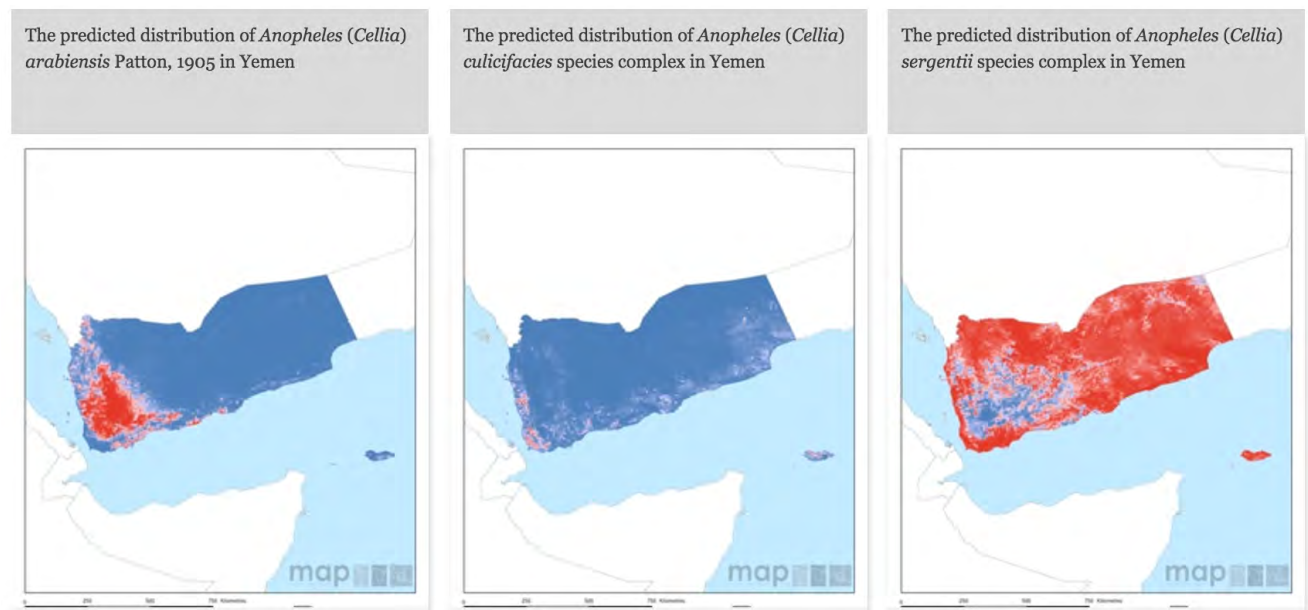
any given area, but these changes are slow and not a consideration in Yemen for the recent and current time period under consideration.

ALTITUDE AND RISK POPULATION

The geographical concentration of malaria vectors in Yemen largely follows altitude and habitat (See Figure 6). Few, if any, mosquitoes breed at high altitudes (>2000 mASL) and therefore the risk of receiving an infective bite is reduced significantly. Risk normally increases fairly linearly (depending on other factors) from higher to low altitude. In practice, this normally means that a person living at low altitude (coastal areas) where malaria is endemic, may receive 4 or more infective bites per year, and fall ill with malaria each time. Children take several years to prime and develop their immune systems and exposure to malaria multiple times a year at a young age makes them highly vulnerable to disease and risk of death. However, those who receive treatment in time, surviving regular infections, tend to develop partial immunity to more severe malaria infection. This significantly reduces their risk of death from infection in older childhood and later years.

In very high transmission (5-10 infections/year) areas (such as the western coastal areas) partial immunity develops as early as 4 years old. In more moderate (2-4 infections/year), transmission areas, children take longer to develop partial immunity, reaching some protective level usually between the ages of 5 and 8. Epidemics amongst host communities in these high to moderate transmission area should not occur, however epidemics are likely to occur in these areas if communities from low or no transmission are displaced into the higher transmission areas. It is not unusual for children up to their early teenage years in moderate transmission areas with short transmission seasons to develop severe malaria disease symptoms if they do not have access to effective malaria case management. In areas of low transmission (>1500/2000 mASL) children and adults suffer from too few infections each year (1 or less per year) to develop partial immunity to severe disease. Under normal circumstances a host community would be at low risk of infection because there are few infective mosquitoes at these higher altitudes. However, in the event of a malaria epidemic, all age groups in the host community will be at risk of infection and developing severe disease symptoms and dying as they have no immunity to severe infection.

Figure 6: Vector prevalence and distribution in Yemen⁶



Many population centres are historically established on the highest accessible ground at least in part to minimise the nuisance level of mosquitoes, other insects and the diseases may be transmitted as a result. This is true of Yemen, where population centres tend to predominate on the higher altitude plains¹² and should be accounted for in any planning of control programmes in the four governorates. **This has operational implications for planning of prevention programmes and the potential suitability of LLINs and IRS in the different settings in each governorate. In low transmission areas communities may be less receptive to regular use of LLINs, even when available, because they are living/sleeping with few nuisance insects in their homes. In the event of an early stage epidemic, LLINs are unlikely to prove an effective means of controlling transmission. Indoor residual spraying (IRS) is likely to be the more appropriate prevention tool to use in most of the larger urban settings/ population centres where these are positioned in the higher altitude areas. Experience across many countries has shown that communities that suffer low rates of nuisance insects in their homes and few insect bites are less likely to perceive the value of using and sustaining use of LLINs. Sleeping under LLINs raises temperature and is often linked with messages that ask people to change their behaviours whereas IRS does not require household behaviour change, does not increase**

temperature for the user, and cannot be used / misused for alternative purposes.

In general, communities in high transmission areas (i.e. low altitude) are generally more receptive to the use of LLINs and IRS, if available and sensitized. This is because they are living and sleeping with the nuisance of many insects in their homes and perceive the value LLINs for reducing bites and improving sleep, etc. Receptivity to regular use of LLINs amongst households in areas of moderate malaria transmission (medium altitudes) can be highly variable and they will in general need greater levels of sensitisation to achieve sustained uptake and correct usage of LLINs. This can be crucial in emergency situations as risk factors escalate to a point where outbreaks of the disease amongst this community is increasingly likely.

Since the MPR and MIS the country has been plunged into conflict; populations have been displaced on mass, access to functioning health facilities has significantly reduced and food insecurity, famine and malnutrition have escalated, now affecting the majority of the population. These changing factors have potentially significant consequences for people's vulnerability to malaria infection, risk of epidemics, and their chances of survival if infected.

¹² www.atozmapsdata.com/zoomify.asp?name=Country/Modern/Z_Yemen_Pop

SOCIOECONOMIC CONSIDERATIONS AND MAN MADE RISK FACTORS

Alongside geographic variability other socioeconomic factors are important in considering malaria's presence in Yemen. Country figures for disease prevalence range between 12.8% and 18.6%¹³. A gender bias has been noted with men being more at risk than women but the study samples published are small and should be approached with caution as it may not be representative on a wider scale. This reported bias, if true, may be more indicative of the cultural norms and traditions preventing health seeking behaviours by women, and a lack of female health workers, but more data is needed to clarify this point¹⁴. A rural bias also exists (23.6% rural disease rates compared to 5.6% in urban areas¹⁴) which may be attributed to a number of factors. Lower incomes, more commonly associated with rural areas, feed into structural issues, such as quality of housing, nutrition, sanitation and healthcare, all known risk factors for malaria. WHO states that 75% of the rural population does not have easy access to healthcare services¹⁴. Furthermore, a rural bias may also implicate forms of employment as a risk factor as households headed by fishermen and those working with livestock are noted to have higher rates of transmission¹⁵.

This occupational variation suggests exophilic behaviour of mosquitoes, in particular *An. arabiensis* and *An. sergentii* as known outdoor feeders. In Yemen this is likely to be an important factor⁸ and as such should be taken into account when designing prevention programmes for populations in this vector's geographic territory.

With the understanding that geographic areas of malaria transmission change very little over short time periods of a few years, this begins to demonstrate how annual malaria burdens of any given malarious geographic area can still be subject to significant changes beyond what geographic indicators may suggest. Mass population movement, break down in access to health care services or other factors that result in lowered immune status, such as severe food insecurity/famine and malnutrition are all factors that can affect malaria burden of an area. These factors can either increase risk of becoming infected (displacement, living in temporary shelter, compromised immunity, etc.) or increase the likelihood of clinical malaria infections deteriorating into severe and complex disease forms, that may result in death. Occasionally, some areas that may not historically have reported malaria, may start to report cases, though these are usually imported cases, rather than reflecting any changes in local transmission risk. This is still an important consideration within this context though, when reviewing data across periods of conflict and population displacement.

¹³ www.researchgate.net/publication/50377218_Clinical_situation_of_endemic_malaria_in_Yemen

¹⁴ www.ncbi.nlm.nih.gov/pubmed/21399597

¹⁵ <https://parasitesandvectors.biomedcentral.com/articles/10.1186/1756-3305-7-351>

Figure 7: Some examples of housing in rural areas in Taizz. Images b-d represent the most common types of housing⁹



Figure 8: Examples of infrastructure in urban settings (Al Hudaydah port)¹⁶



The conflict in Yemen has created widespread population movement, pushing many to leave their place of origin to seek greater security elsewhere within Yemen. **This population of Internally Displaced People (IDP) is likely to be more exposed to vectors as well as less capable of coping with health and economic pressures, making them a people group of particular vulnerability (see**

section on displacement). It is common for IDPs to seek security in urban centres, contributing to overcrowding and overburdening of already poorly functioning services and increasing the disease transmission conditions. Figures 7⁹ and 8¹⁶ show examples of infrastructure pre-conflict in urban and rural settings. The changes and variability in infrastructure need to be accounted for in designing control programmes to suit the structures present and provide efficient coverage. Potential integrated vector management using either LLINs, or IRS, and potentially also use of larvicide may be required to better control the malaria vectors common to these areas.

These man-made risk factors for increased malaria transmission, risk of infection and increased epidemic risk are strongly apparent in some of the most vulnerable communities of the Tehama Region. Other vector borne diseases are also affected by environmental and manmade factors and present

¹⁶ <http://en.farsnews.com/newstext.aspx?nn=13931223001090>

varying levels of risk to these communities. This offers varying levels of opportunity for potential control of malaria and importantly, opportunities for synergy where control activities for other VBDs present can be integrated. These will be discussed in more detail in subsequent sections of this report and recommendations. Identifying those communities currently most at risk, and those likely to become most at risk in the coming months, requires a more in depth look into the available epidemiological data for 2016 and 2017 and further analysis of the environmental and man-made risk factors that affect the country.

INSECTICIDE EFFICACY

There is extensive pyrethroid resistance amongst mosquitoes in all East African Countries, including all those that have trading routes with Yemen. Whilst Pyrethroid and DDT resistance have been detected in Yemen⁵, there are no peer-reviewed published reports and insecticide efficacy monitoring was just being established through nine sentinel sites in 2012. Conflict has disrupted all normal activities, including efficacy monitoring. However, as of 2015, local data indicates that vectors are susceptible to carbamates⁵. This is the class of insecticides used for IRS in 2016/17 in Yemen and it should be effective and provide several months protection against malaria, if the insecticide is used and applied correctly. The residual life of the insecticide will vary depending on the type of shelter materials which make up the internal wall surfaces, and ranges from around 3 months when sprayed onto mud surfaces, up to 5 months when sprayed onto brick, cement or other hard surfaces (wood, metal, etc.). It is recognised that there are many gaps in insecticide monitoring data, and this needs additional support to ensure that the efficacy of a range of insecticides is monitored on a regular basis.

The purpose of this report is to give an overview of the epidemiology of malaria in Yemen and, in light of the current context, how available funding may be used to greatest effect to target the most acute needs. Historic data and mapping has identified the Tehama region as a key area in terms of malaria control, as well as some areas in the south. More recent data, accounting for man-made risk factors, has been used to develop levels of prioritisation for interventions that combine established

environmental risk factors with recent challenges posed by these man-made factors. The first layer of prioritization will identify four governorates which this assessment will analyse first on the basis of their relative case burden when compared to the rest of Yemen. These governorates are Sa'ada, Hajjah, Al Hudaydah and Taizz and are all affected severely by conflict, population displacement and historically by malaria, to varying degrees. There will also be analysis of pockets of high transmission beyond these governorates, predominately within the Tehama region but also including key areas in southern governorates, which exhibit a combination of the geographic and man-made risk factors discussed. The following tables and figures used to carry out these analyses provide the most up to date information on the caseload of malaria over recent years, thanks to NMCP cooperation and guidance.

THE TEHAMA REGION

Geographically, it is well established that the area in Yemen known to be at highest risk of transmission of malaria is the Tehama region. This covers the coastal plains running down the western side of the country where lower altitudes support higher rates of transmission. As such, the following governments that comprise this area have been selected to assess how disease risk is expressed in each. Districts should be identified where control efforts can be targeted in order to most effectively address the burden of disease:

Table 3: Pf confirmed cases 2017 for Tehama governorates

Governorates	P. f cases (weeks 1-19, 2017)
AL HUDAYDAH	32,701
AL MAHWEET	1,292
AMRAN	1,239
DHAMAR	1,278
HAJJAH	13,038
IBB	459
RAYMAH	500
SA'ADA	679
TAIZZ	1,775
Total	52,961

Figure 9: Tehama governorates highlighted in dark red for areas where disease burden is known to be high and light red for additional governorates of concern

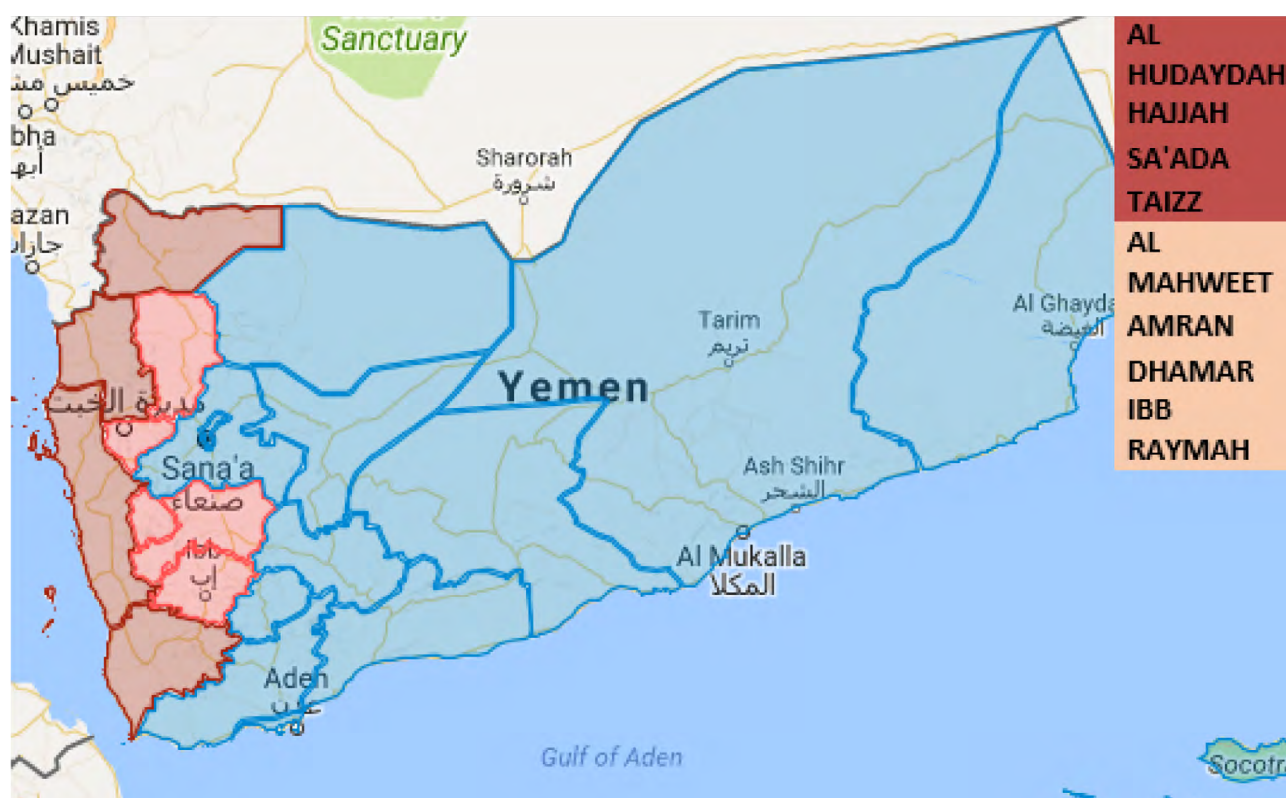


Table 3 shows the caseload of confirmed cases of malaria weeks 1-19 of 2017 across the Tehama region, confirming the governorates with the highest burden. The Tehama region as a whole however, expresses similar adverse conditions for increased disease transmission extending beyond these four governorates (figure 9). Epidemiology across the Tehama region will be assessed at a district level to better understand areas that are at risk of outbreaks or epidemics of malaria that could be included in a national approach to malaria control efforts. In addition to geographic susceptibility, other socioeconomic risk factors and considerations will be assessed to better to describe relative caseloads and pinpoint pockets of concern for intervention. These will particularly focus on displacement and malnutrition, both understood to complicate and increase vulnerability to malaria.

OTHER HOTSPOTS OF MALARIA TRANSMISSION

In addition to the governorates already clearly outlined as displaying greatest risk of malaria transmission, predominantly concentrated in the **Tehama region**, both Figures 2 and 3 show various other hotspots of malaria transmission. These appear to be dotted along the southern coast and may mark important points of additional intervention for outbreaks and epidemics that are occurring here. On this basis, five further governorates have been selected to identify to what extent these hotspots are of importance and can be targeted as part of the recommendations for a comprehensive national strategy for malaria control. These governorates are **Lahj, Aden, Abyan, Shabwah and Al Mahra** (see figure 10).

Figure 10: Governorates selected to be analysed in this report on the basis of Pf prevalence and other contributing risk factors

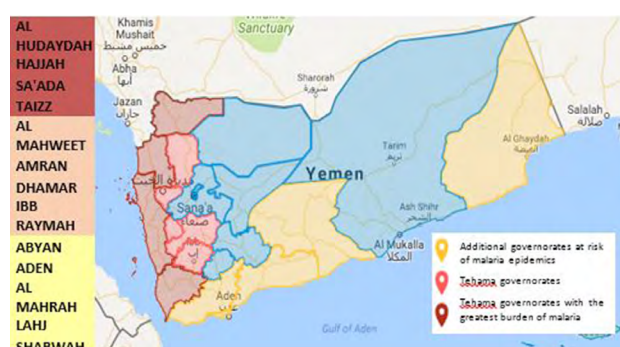


Table 4: Pf confirmed cases 2016 and 2017 for Southern governorates

Governorate	2016	2017 (weeks 1-19)
Abyan	2,457	108
Aden	2,258	2,928
Lahj	655	547
Shabwah	N/A	813
Hadramout	131	45
Al Mahra	896	380

This report also recognises that underreporting is a widespread complaint under the current circumstances. Areas of interest in these southern governorates are mostly in strata 1 and 2 which would account for some increase in numbers still to come towards the end of the year based on seasonality. Even so, a comparison between 2016 and the data available so far for 2017 (table 4) appears somewhat inconsistent. These governorates have been selected on the basis of their geographic capability of supporting vectors rather than case burden alone.

Hadramout has not been included given that there have only been 45 cases reported so far in 2017 but the report recognises that it has historically been of interest in malaria control. In the interest of

focussing a response it is suggested that Hadramout should not be a priority area for increased support. The coastal regions of these governorates, at lower altitudes, offer a more favourable environment to vectors however, the more eastern areas of the country, particularly inland, tend to be predominately desert and likely to be too dry to support breeding sites.

Having now established a relatively large geographical area of susceptibility to moderate to high risk of transmission, case data from the past two years will be used to give greater clarity of areas that require targeted intervention.

MOPHP MALARIA DATA – 2016 AND 2017*

Health facility data collection and the corresponding national malaria data has been weakened since 2014 when MoPHP data collectors ceased to be paid. Given the complex environment in which it is collected, it should be noted that there is no currently available analysis of how representative recent national malaria data is, in terms of urban to rural health facilities, or details of the percentage of health facilities reporting each month. However, in most conflict settings surveillance data tends to be skewed to be more representative of the more accessible urban communities and less representative of rural, village-based communities and is therefore likely to understate the true malaria burden. Accepting the limits of the malaria data, this assessment has reviewed all available malaria data to date, combined with information on factors likely to complicate or exacerbate malaria transmission and risk amongst vulnerable communities, to inform recommendations on case management and prevention activities.

The 2016 malaria case data (table 5) for 2016 by governorate shows that, of the total cases, >99% of microscopy confirmed malaria cases were Pf. Other species appear to be of no real importance in Yemen (although this may be more a reflection of confirmatory diagnostic specificity available).

Table 5: MoPHP malaria case data 2016 by governorate. Data in Annex 3

Malaria cases 2016 by governorate																
Governorate	Attendents										confirmed cases	clinical cases	total cases	Treated cases by national policy	Admitted cases	Deaths
		RDTs		Microscopy		spacies										
		Total Subjects	Total Positive	Total Subjects	Total Positive	PF	PV	PM	PO	MIX						
Alhodidah	720792	38209	13616	392126	17728	17345	173	0	0	0	31344	17254	48598	27546	298	8
Lahaj	276143	2324	483	25636	655	655	0	0	0	0	1138	769	1907	1436	25	2
Almahweet	240575	5699	2231	10445	2232	2228	4	0	0	0	4463	6421	10884	7731	11	0
Hajjah	687,321	30,459	8,856	80,649	8,937	8,832	105	0	0	0	17793	3,386	21179	16,231	321	11
Abyian	415237	0	0	186913	2457	2457	0	0	0	0	2457	0	2457	0	1	0
Taiz	479755	12801	1546	140001	3150	3149	1	0	0	0	4696	433	5129	4470	235	0
Hadramout	903952	238	0	523	131	131	0	0	0	0	131	1	132	131	69	0
Almarah	61550	2923	340	4876	896	896	0	0	0	0	1236	0	1236	1236	20	2
Amran	501700	7882	3074	9090	1511	1493	18	0	0	0	4585	1995	6580	5616	581	8
Sadaah	331408	46298	15051	6642	1771	1509	0	0	0	262	16822	7275	24097	16812	111	32
Marieb											0		0			0
Aljouf											0		0			0
Albidhaa	38157	7	1	1108	130	119	11	0	0	0	131	143	274	238	0	0
Dhamar	333527	3291	922	13593	1861	1861					2783	164	2947	1549	18	0
Ibb	395092	8645	1862	28009	939	939	0	0	0	0	2801	176	2977	2583	40	0
Rimah	34118	4566	2008	5324	673	665	8	0	0	0	2681	263	2944	129	0	0
Shabwah											0		0			0
Sogatraa											0		0			0
Aldhalee	129010	7259	106	9592	63	63	0	0	0	0	169	208	377	12	0	0
Sanaa City	218194	0	0	2784	23	23					23		23			0
Aden	325641	0	0	19523	1158	1158	0	0	0	0	1158	468	1626	970	40	0
Sanaa gov	309124	2555	729	4952	872	826	46	0	0	0	1601	2336	3937	755	0	0
Total	6,401,296	173,156	50,825	941,786	45,187	44,349	366	0	0	262	96,012	41,292	137,304	87,445	1,770	63

Comparison of historical malaria records (figure 11) demonstrates that confirmed Pf malaria case reporting since 2012 has fallen dramatically each year in parallel with the deteriorating security context. NMCP have confirmed that data collection has been compromised since 2014, due to staff not being paid, therefore apparent reductions in reported cases may not fully represent success with malaria control, rather the breakdown of disease surveillance and health infrastructure. However,

despite the same continued security deterioration in 2017, the reported malaria case records for the first 19 weeks of 2017 alone already significantly exceeded the total reported malaria cases nationally for the whole of 2016. This indicates a sharp rise in malaria transmission, compared to 2016, that is likely to continue at similar rates without significant and rapid intervention. (Data for the following graphs in Annex 3).

Figure 11: Graph of annual malaria cases reported in Yemen, 2005-wk19 2017

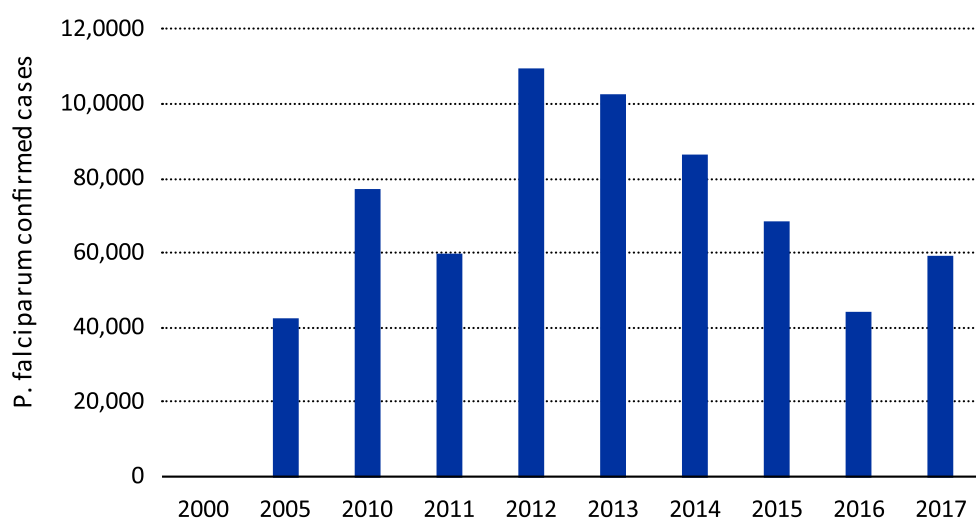
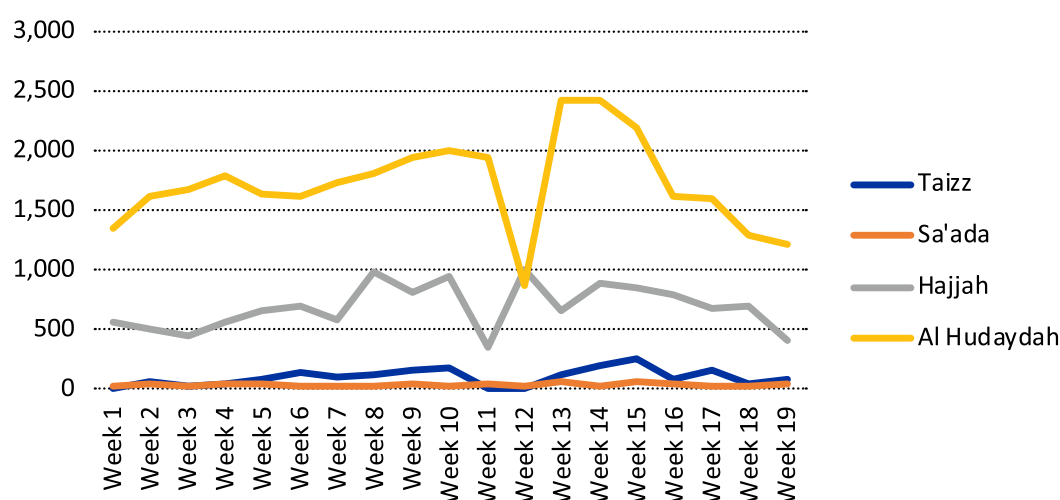


Figure 12: Graph to show malaria cases weeks 1-19, 2017

Al Hudaydah had the greatest burden of malaria with a total of 31,344 confirmed (by RDT + microscopy) malaria cases (2016). Hajjah experienced the second highest burden with 17,793 confirmed cases. Sa'ada, whilst low in relative malaria prevalence in the 2013 MIS report, recorded 16,822 confirmed cases in 2016, making it the governorate of third highest prevalence. Al Hudaydah, Hajjah and Sa'ada together reported 69% of the total confirmed malaria cases in 2016. Taizz reported the next highest caseload, with 4,696 confirmed cases, not significantly greater than the reported burden in Al Mahweet (4,463) and Amran (4,585). Taizz remains of particular concern, however, given that it remains an area that is very severely affected by the conflict. These four governorates with the highest disease burden for malaria are all located in the Tehama region. Data from 2016 appears to be roughly consistent with emerging trends from 2017 so far (weeks 1-19) with Al Hudaydah recording by far the highest caseload and similar concentration of cases across the Tehama governorates.

Basic comparison of the malaria cases reported in the two governorates reporting the highest caseloads (Hajjah and Al Hudaydah: >50% 2016 cases) between the two time periods (see table 6) indicates, an apparently significant increase in malaria transmission in 2017. Al Hudaydah is shown to be reporting more cases of malaria by week 17 of 2017 than in all of 2016.

The 2017 projected malaria case numbers for Hajjah across the normal malaria season, could be as high as 35,683 for the full year (should numbers continue to increase at the same rate) though there are many

variable factors that could affect this. However, for Al Hudaydah, where malaria transmission is restricted to the shorter period of seasonality, normally not extending much beyond May, the current reported case load is likely to represent the majority of the cases until the start of the next transmission season in October/November.

Table 6: Data showing confirmed cases of malaria for Hajjah and Al Hudaydah, comparing 2016 cases with cases from weeks 1-19, 2017

Governorate	Confirmed Cases Malaria (data from MoPHP)	
	2016	2017*
Hajjah	17793	13038
Al Hudaydah	31344	32344
*weeks 1-19		

Analysis of MoPHP 2017 (weeks 1-19) data (figure 12) at district level of the governorates with the highest caseloads (Al Hudaydah, Hajjah, Sa'ada and Taizz) identifies key districts within the four governorates with the greatest burden of disease (figures 13-16). Further analysis of hotspots of transmission beyond these governorates will occur later in the report, consideration for these require analysis of factors beyond case data alone. In theory the case data should correlate with seasonality, altitude and population geography. However, confounding factors such as access, security, stock outs, and lack of data collection officers, could have biased reporting frequency from individual health facilities in each district and therefore, may have reduced the number of reported cases in

any given area. Interpreting the graphs in figures 13-16 requires some additional cross-checking prior to using the graphs to target malaria control resources and support, as undoubtedly the data does not represent the full epidemiological picture. When malaria case numbers are analysed by week for each district for weeks 1-19 in 2017 (see figures 17-20 below), further levels of important information are available. Firstly, the malaria data

by week confirms the relative reported burden of malaria in each district compared to figures 13-16 but secondly, it also provides some indication of the reporting frequency for the district. This can be used to establish if the reported total malaria data for the given period is likely to be representative of the real malaria burden or if the recorded case totals are actually underrepresentative of the true caseload.

Figure 13: Al Hudaydah total malaria cases in wk 1-19, 2017

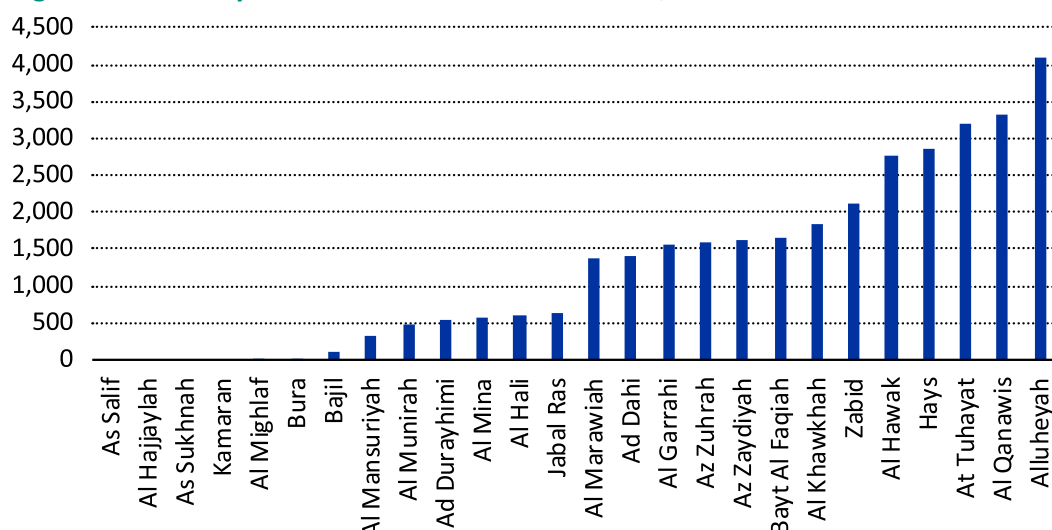


Figure 14: Taizz total malaria cases in wk 1-19, 2017

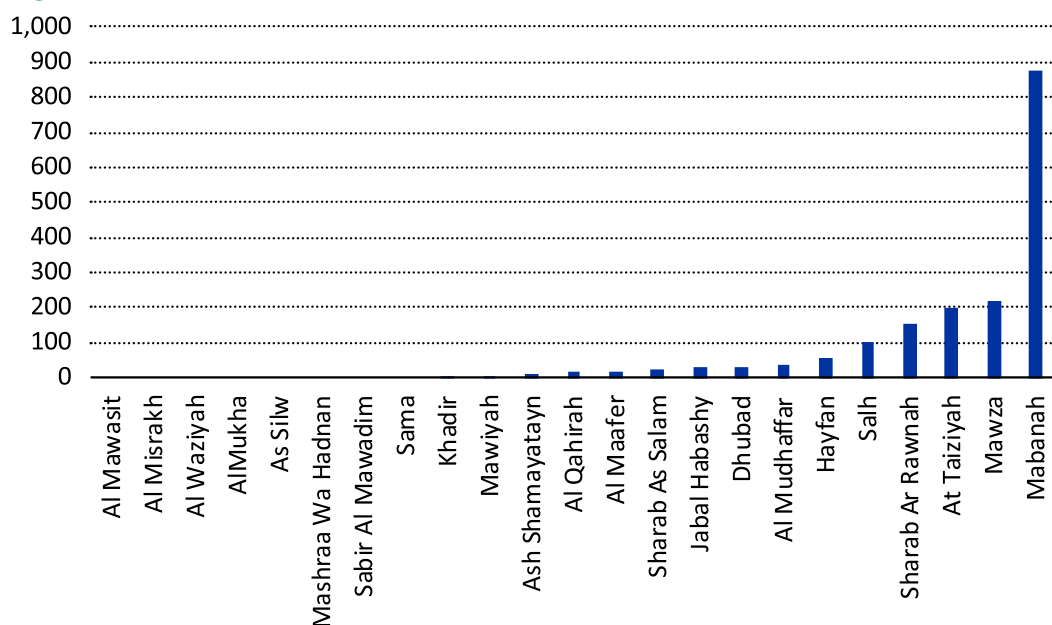


Figure 15: Hajjah total malaria cases in wk 1-19, 2017

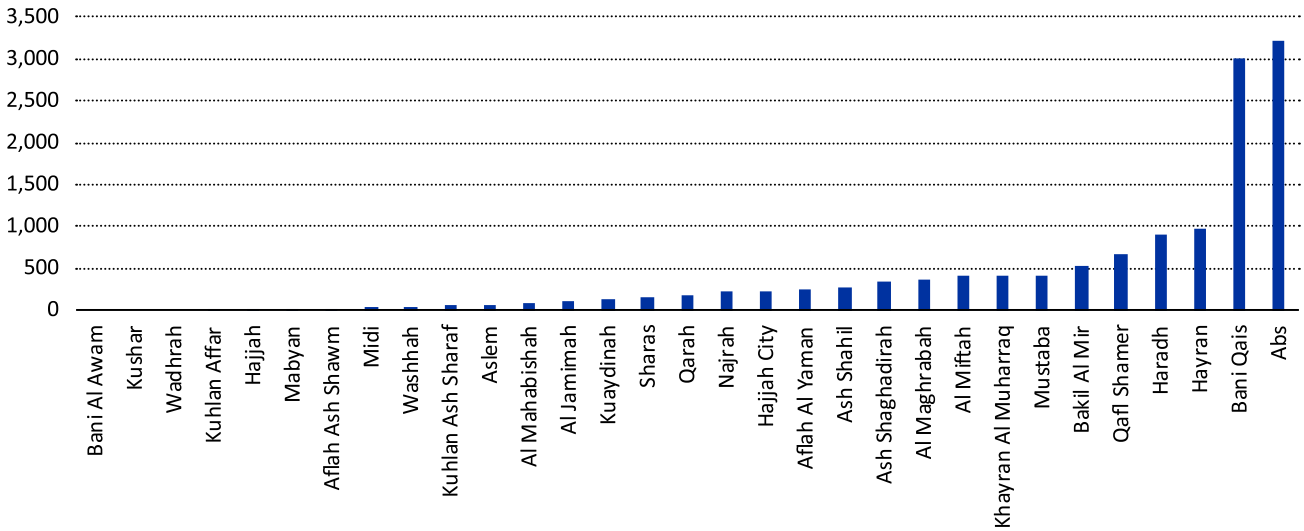


Figure 16: Sa'ada total malaria cases in wk 1-19, 2017

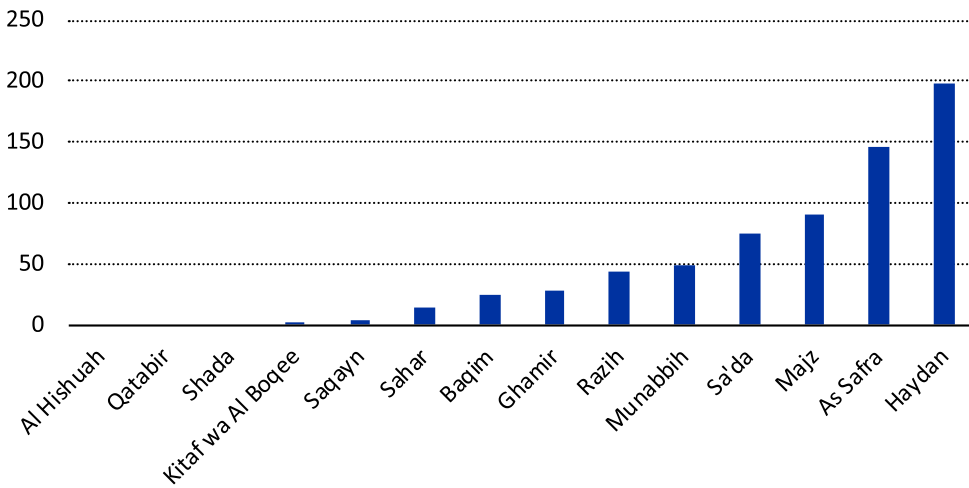


Figure 17: Al Hudaydah malaria cases, by district, wk 1-19, 2017

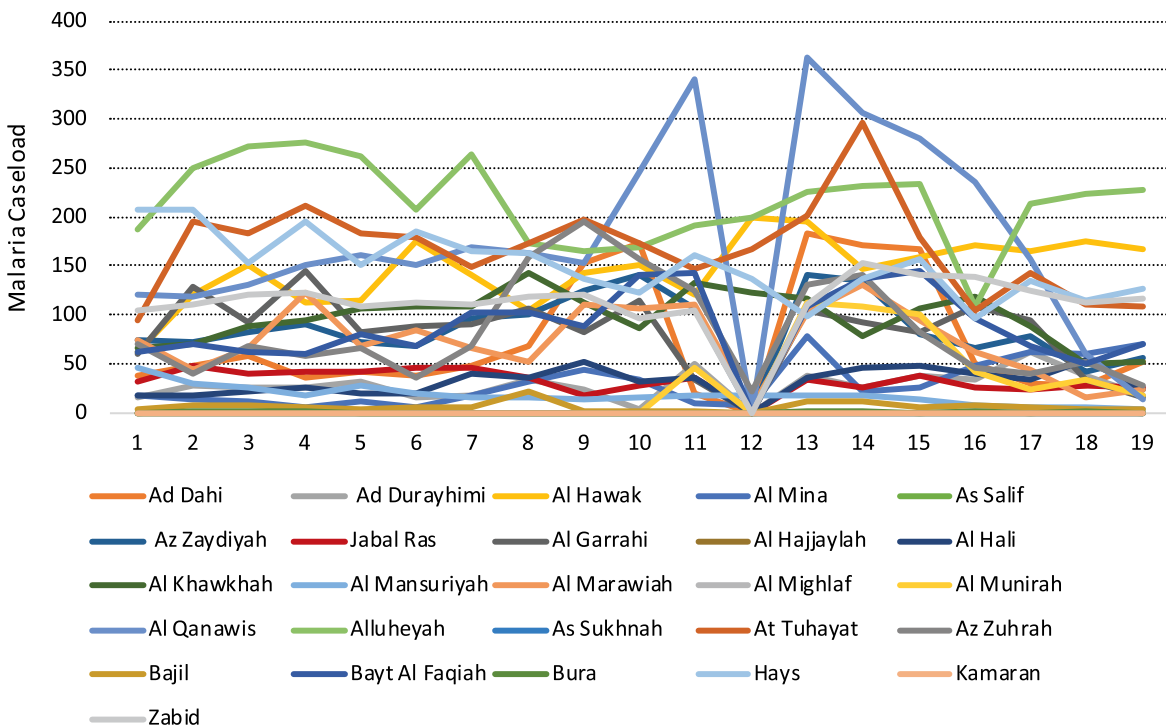


Figure 18: Hajjah malaria cases, by district, wk 1-19, 2017

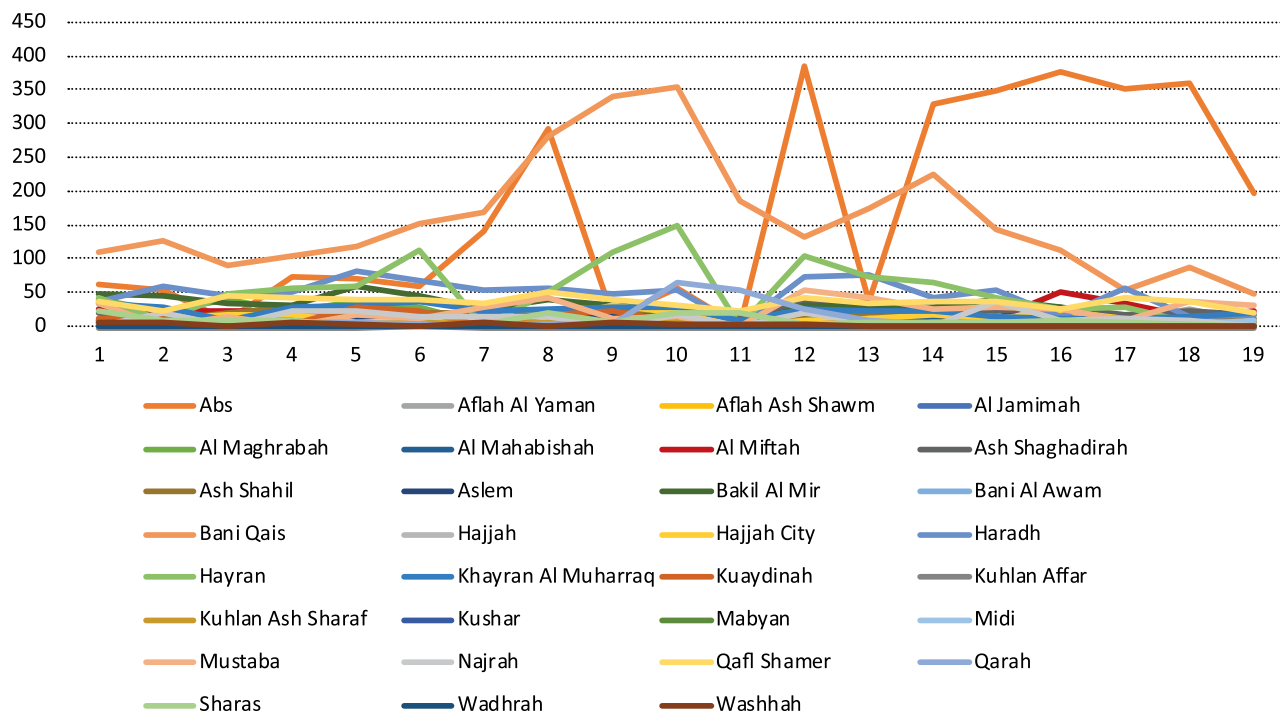


Figure 19: Sa'ada malaria cases, by district, wk 1-19, 2017

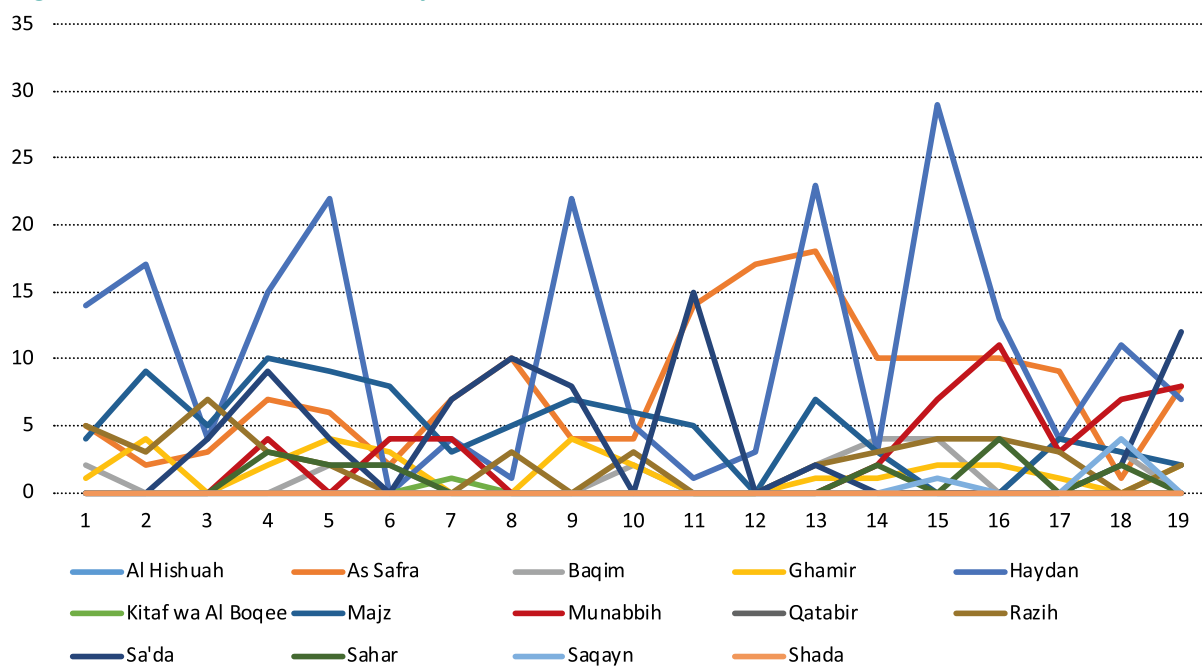
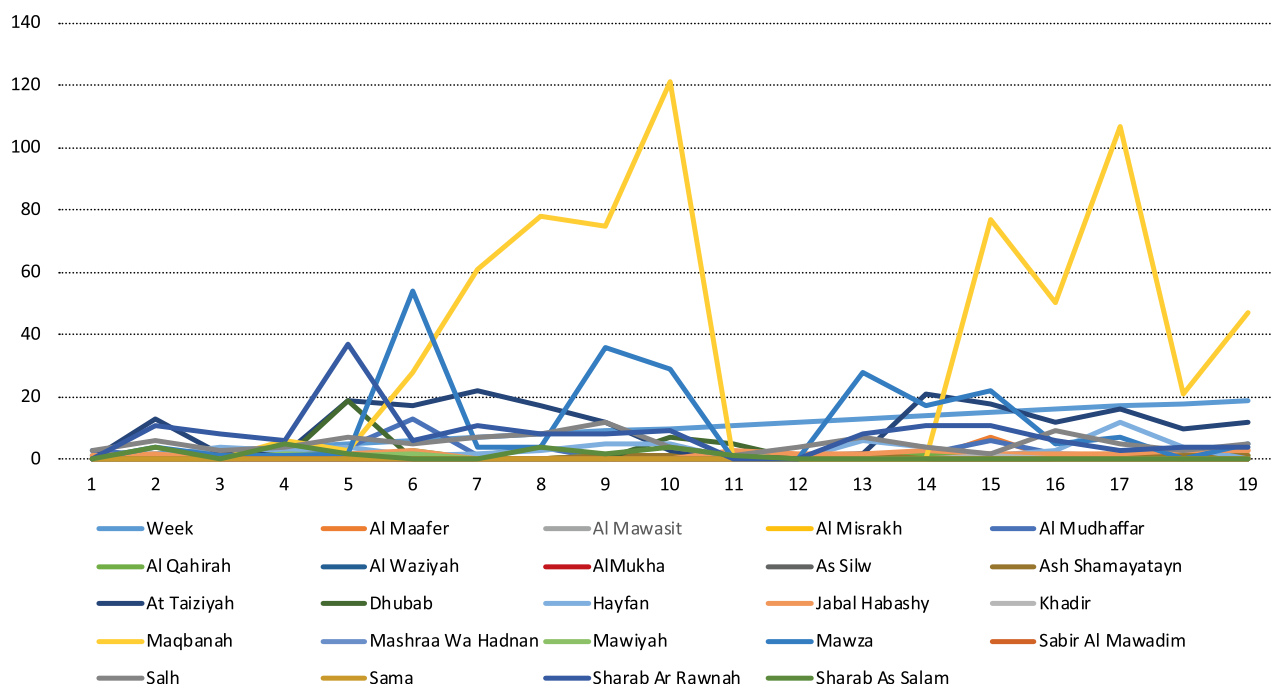


Figure 20: Taizz malaria cases, by week, wk 1-19, 2017



Initial analysis will focus on the four governorates that have the highest burden of disease. Discussion of interacting risk factors will then be considered before carrying out further district level analysis of areas beyond this that may be important sites of intervention.

MALARIA ANALYSIS BY GOVERNORATE/DISTRICT for high burden governorates

SA'ADA

Every district reporting malaria cases across Sa'ada (figure 19), regardless of the relative case burden which the district reported overall, demonstrated highly erratic reporting frequency. The districts of Haydan (2090mASL) and As Safra (2642mASL), with the overall highest case numbers (figure 16) demonstrate the current problems faced by NMCP and the country partners in assessing malaria burdens. Haydan district has four health facilities serving the population and all four submitted some malaria case reports between Wk 1-19. However, the graph shows 5 peaks of malaria cases reported in Haydan, correlating reporting weeks 2, 5, 9, 13, and 15. These reported case peaks, only a few weeks apart from each other do not demonstrate epidemiological changes (epidemics or seasonal peaks) rather, the troughs in between each peak of

the graph, simply confirm the absence of reporting for that given week or weeks (15 weeks appear to be unreported). The more severe the peak and trough, the more severe the infrequency of reporting (number of functioning health facilities in the district that were able to report), as each district has a number of functioning health facilities at any one time. Overall, there were less than 200 malaria cases reported from Haydan in the 19 week period but, given the gaps in weekly reporting, it would be safe to assume case numbers in weeks for which no report was given are roughly equal to the mean of the previous and following reports recorded in Figure 19. Assuming that, the total number of cases seen at the 4 health facilities in Haydan for the 19 weeks is likely to have been at least double the reported figure.

Likewise, in As Safra district the overall malaria case numbers for weeks 1-19 was less than 150. Reporting from this district (figure 19) does not appear to be as erratic as in Haydan district, with fewer apparent missed reporting weeks. However, As Safra has 7 health facilities serving the local communities and **only 3 health facilities (Damaj Hospital, Neshoor HC, and Wadeah HC) have reported cases during this first 19 weeks.** With less than half of health facilities reporting epidemiological data (possibly due to insecurity, access, staffing, etc.), it is again indicative that the true malaria case burden is likely

to be significantly higher than that which has been reported.

This analysis assumes that health facilities with reported malaria cases in some weeks and zero cases attributed against their names for other weeks in epidemiological reports made available to date, represent an infrequency in health facilities submitting epidemiological reports to the MoPHP. Given that Sa'ada is the site of significant insecurity (examined in further detail later in the report), the gaps in reporting may well explain, at least part, why the overall reported case load appears to be significantly lower than in 2016 (figure 11). We know that insecurity must logically also be reducing access to health facilities and consequently the malaria cases seen by the national health facilities, leaving an unknown number unreported.

Of greater importance when reviewing malaria risk for Sa'ada in 2017, is consideration of the seasonality of disease transmission. The majority of Sa'ada sits at between 1000 to 2000mASL, and the malaria transmission season for most of the governorate normal extends from July to September. **The 2017 data for weeks 1-19 therefore represented the period in which minimal transmission is occurring, and the vast majority of cases will occur over the next 3 months. It should therefore be assumed that confirmed malaria cases will match, or exceed (as a result of decreased HF access and increased malnutrition), the 16,822 confirmed cases in 2016.**

TAIZZ

Taizz District	Health Facility	Pf positive cases (wk1-19, 2017)
Maqbanah	Al amerah Aljmahrh HU	41
Maqbanah	Albrh H	0
Maqbanah	Alprasha HU	187
Maqbanah	Alrbat Ashaoup HC	0
Maqbanah	Alwhda HC	324
Maqbanah	Hameer Aljpal HC	43
Maqbanah	Hjdah Hospital	283

Maqbanah was the only district of Taizz governorate that reported a relatively significant malaria case load (figure 14) in the first 19 weeks of 2017. Its population is served by a total of 7 health facilities, of which 5 (table 7) have reported during the period. The number of cases occurring within this district

were however, under reported overall because no epidemiological reporting was made for weeks 11, 12, 13 and 14 (presumably either as a result of insecurity, access, or logistical/HR reasons). Cases in weeks 10 and 17 exceeded 100 per week. It would be reasonable to assume that as many as 400 cases may have occurred during the 4 weeks with missing data, as transmission could not simply cease for the period in question. If that assumption is applied to the total reported case load (>850) for Maqbanah in weeks 1-19, then the true case load seen at the district level health system would have been >1,200. The majority of reported cases in Maqbanah were reported from Alprasha HU, Alwhda HC, Hjdah Hospital. The bulk of the population in this district live in areas of moderate altitude 600-1000 mASL where malaria transmission is moderate and seasonally is less well defined, extending through the winter (from October-April) at lower levels, and then in the summer through May-September.

Given the above range of transmission for Taizz, malaria risk should now be low in all locations, until transmission begins again in the winter (October onwards, depending upon climate, etc.)

HAJJAH

In the first 19 weeks of 2017, a total of five districts in Hajjah reported significant malaria case-loads (figure 15). Of these, two districts (Abs and Bani Qais) stood out with over 3000 cases each. Abs is served by 6 HFs, of which 5 have reported. Bani Qais has 7 HFs, all of which have reported. The other three of significance are Hayran, Haradh and Qafl Shamer. Hayran has only 2 HFs and both have reported. Haradh has 5 HFs of which all 5 have reported, and Qafl Shamer has 6 HFs, all of which have reported (table 8). The remaining HFs in Hajjah have reported relatively insignificant burdens of malaria. So for Hajjah, reporting rates from the 4 out of 5 districts with the main malaria burden appear to be reasonably good and likely to be fairly representative of the actual malaria cases seen by the HFs in those 4 districts (figure 18). Reporting frequency for HFs in Abs however, was poor with no reports provided for weeks 9, 10, 11 and 13, and the malaria case load should be assumed to be as much as double that which was reported for Abs. It is not possible to assess the number of cases occurring in the community but not presenting at MoPHP HFs, and this is likely to be quite significant given the security issues and access to health facilities (discussed in detail on follow on sections of this report) in each of the four priority governorates.

Table 8: Malaria cases in five districts, Hajjah, wk 1-19, 2017

District	HF	P. falciparum Positive
Abs	Abs Rural Hospital	2,600
Abs	Al Rdhah HU	5
Abs	Dr. Mohammed Mangar Clinic	339
Abs	Dr. Abdalh Assar Center	260
Abs	Tabah center	0
Abs	Tihama region center	5
Bani Qais	Al lohah center	395
Bani Qais	Al Masray Center	355
Bani Qais	AL Qadsi Dispensary	1,660
Bani Qais	As Sarhah HU	75
Bani Qais	Bani Aid HU	75
Bani Qais	Bani Qais Health Center	376
Bani Qais	Bani Saifan HU	64
Hayran	Al hayah Clinic	338
Hayran	Hairan HC	636
Haradh	Al Hatan Health center	352
Haradh	Hajar center	452
Haradh	Shalilat Bani Alhadad HU	89
Qafl Shamer	Al ghfaliah HU	8
Qafl Shamer	AL Sfaa Dispensary	284
Qafl Shamer	Alajarema HU	236
Qafl Shamer	Almekhlaf HU	67
Qafl Shamer	Bani Jel HU	32
Qafl Shamer	Qafl Shamer Kufl-Shamar Rural H	39

AL HUDAYDAH

Al Hudaydah represents the lowest altitude governorate of the four and suffers the greatest burden of malaria (figure 13), with over 32,836 cases in the first 19 weeks 2017. However, this reporting period covers the last 4 out of 7 months of expected malaria transmission for the coastal region. Cases are expected to be low (normally) in most of the governorate between June-September and will begin to rise again from October onwards. There are 26 districts, all of which are malaria endemic to varying degrees. Of these 26 districts, five reported a total of 500-600 cases each in weeks 1-19, seven reported 1,000-2,000 cases, and six reported 2,000-4,000 cases (highlighted in blue in Table 9).

In the six districts with the highest reported cases loads of malaria, 38 of 44 HFs have been submitting epidemiological reports. Apart from week 12 (see figure 17) reporting frequency was reasonably good. Consequently, it appears as if the overall malaria case reporting (figure 13) is largely representative of the number of cases presenting at MoPHP HFs in Al Hudaydah.

However, as in Hajjah, there is no means of accurately determining the number of malaria cases that occurred within the communities that did not have access to functioning HFs during the reporting period and this is likely to be a very significant factor for this governorate, discussed under the following section of this report.

Governorate	District	Health facilities reporting
Al Hudaydah	Ad Dahi	2/4
Al Hudaydah	Ad Durayhimi	4/7
Al Hudaydah	Al Hawak	11/14
Al Hudaydah	Al Mina	10/12
Al Hudaydah	As Salif	0/3
Al Hudaydah	Az Zaydiyah	1/5
Al Hudaydah	Jabal Ras	4/5
Al Hudaydah	Al Garrahi	6/7
Al Hudaydah	Al Hajjaylah	0/5
Al Hudaydah	Al Hali	5/13
Al Hudaydah	Al Khawkhah	3/4
Al Hudaydah	Al Mansuriyah	4/4
Al Hudaydah	Al Marawiah	5/5
Al Hudaydah	Al Mighlaf	1/4
Al Hudaydah	Al Munirah	2/2
Al Hudaydah	Al Qanawis	5/5
Al Hudaydah	Alluheyah	5/5
Al Hudaydah	As Sukhnah	0/6
Al Hudaydah	At Tuhayat	10/10
Al Hudaydah	Az Zuhrah	2/8
Al Hudaydah	Bajil	5/6
Al Hudaydah	Bayt Al Faqiah	9/10
Al Hudaydah	Bura	1/3
Al Hudaydah	Hays	2/5
Al Hudaydah	Kamaran	0/1
Al Hudaydah	Zabid	5/5

HEALTH FACILITY FUNCTIONALITY

Having considered the reported malaria case totals for governorates of highest disease burden by district, including the number of and frequency of health facilities reporting data, above we have identified the districts (and related health facilities) managing the most important burden of malaria cases in each governorate. This may however, represent only a partial view of the respective malaria burden for the given area depending on the degree of access and utilisation of health services by people in each HF catchment area and populations who have no access to health facilities within a half a day's walk. It is therefore important to understand these two key factors as far as possible.

The HeRAMS report, defines a health unit (HU) as the first point of contact between service provider and client to provide preventative services, health education, and basic curative care¹⁷. The HU should be made up of at least four health staff who then refer more complex cases on to Health Centres (HC),

defined as having at least 17 staff. HCs refer severely ill patients to district hospitals, the highest level of which is the governorate hospital (>100 beds). A functioning health system for any given area is defined as:

- 1 Health Unit per 1,000–5,000 individuals
- 1 Health Centre per 5,000–2,000 individuals
- 1 District Hospitals per 60,000-150,000 individuals (30-70 beds)
- 1 Governorate Hospital per 300,000 individuals (>100 beds)

All four governorates fell far below these measures of functioning (tables 10 and 11¹⁷) in 2016. Of the four governorates with the greatest burden of disease, Sa'ada, Hajjah and Al Hudaydah, had the poorest ratio of health services to population. Taizz, with a much lower burden of malaria, had a comparatively favourable ratio of health services to population in 2016.

Table 10: Overview of staffing resources and populations served by health facilities by governorate¹⁷

Governorate	Total HF	Totally Damaged	Partially Damaged	Total	% with damage out of total
Sa'ada	163	24	36	60	37.00%
Hajjah	326	6	16	22	6.70%
Al Hudaydah	384	2	12	14	3.70%
Taizz	425	7	18	25	5.90%
Governorate	HF staff/10,000 population	Total No of Staff	No of Midwives	No of Nurses	No of Districts with ≤2 doctors
Sa'ada	6.3	652	111	169	12/15
Hajjah	10	2,131	340	366	5/31
Al Hodeidah	8	2,494	448	696	12/26
Taizz	13.1	4,246	516	958	10/23
National average	17.03				

Governorate	Health Units (HU)	Population/HU	Health Centres (HC)	Population/HC	Hospitals	Population/H	Beds/10,000
Sa'ada	77	13,341	18	57,069	6	171,206	2.3
Hajjah	235	9,037	36	58,992	11	193,066	1.8
Al Hodeidah	289	10,655	67	45,959	16	192,453	2.1
Taizz	221	14,637	116	27,887	25	129,397	4.5
National average		9,885		36,340		150,190	6.2

¹⁷ www.moh.gov.ye/arabic/docs/Reports/HeRAMS%2016%20Govn%20final%20report.pdf

Table 11: Percentage availability of specific services in health facilities at governorate level¹⁷

Governorate	Child Health and Nutrition		Communicable Diseases		Maternal and Newborn Health		Environmental Health		Management of common/ endemic diseases		
	Full Availability	Partial Availability	Full Availability	Partial Availability	Full Availability	Partial Availability	Full Availability	Partial Availability	HU	HC	Hospital
Sa'ada	67%	18%	45%	22%	37%	27%	29%	53%	5%	14%	67%
Hajjah	89%	4%	68%	11%	47%	18%	69%	23%	8%	33%	70%
Al Hodeidah	77%	12%	54%	15%	25%	29%	36%	34%	1%	2%	33%
Taizz	79%	9%	43%	25%	49%	24%	56%	29%	11%	38%	55%

In 2017, the situation (table 12) has worsened dramatically and access and usage of HF's has fallen to an all-time low. In Al Hudaydah, over half of the health facilities are now non or partially functional and access, as a percentage of the population reached through combined health cluster services, is at just 7%. Hajjah has only 60% of its HF's fully functioning, reaching 21% of the population. Only

29% of HF's are fully functioning in Taizz, reaching 21% of the population, and in Sa'ada only 23% of HF's are fully functional, reaching 27% of the population.

In summary, access to the MoPHP traditional static health system has collapsed and the majority of the population when sick, have no access to health care through MoPHP HF's.

Table 12*: Shows information on health facility functioning and reach by governorate. Highlighted rows show priority governorates. Data provided by MoPHP

Name	Est. Population	Health Facilities			People reached for health through cluster	As proportion of population	Health NGOs	IDPs in	IDPs out
		Total	Not Functioning /partially functioning	Percentage					
Abyan	5,64,917	168	95	57%	1,33,495	24%	11	15,342	6,384
Aden	8,92,807	45	11	24%	4,93,541	55%	17	33,870	33,900
Al Dhale'e	7,11,912	155	123	79%	2,99,915	42%	12	26,928	12,888
Lahj	9,86,597	234	58	25%	1,58,077	16%	16	58,794	33,060
Shabwah	6,25,312	184	78	42%	2,68,237	43%	11	15,894	10,008
Al Hudaydah	31,49,243	384	206	54%	2,29,945	7%	12	1,02,696	50,892
Al Mahwit	7,20,474	not available			56,718	8%	4	44,988	1,482
Hajjah	21,02,909	326	130	40%	4,39,533	21%	13	4,23,492	3,91,596
Raymah	6,01,635	not available			92,318	15%	3	51,540	930
Ibb	28,96,435	365	209	57%	5,24,690	18%	8	1,28,538	9,930
Taizz	28,41,225	425	301	71%	6,09,594	21%	12	2,74,068	5,47,200
Al Jawf	5,68,866	94	86	91%	2,03,687	36%	5	37,818	45,852
Sa'ada	8,30,034	163	125	77%	2,22,177	27%	9	1,03,044	3,15,138
Al Bayda	7,46,599	177	144	81%	1,77,424	24%	7	32,328	29,628
Amanat Al Asimah	29,32,613	86	32	37%	4,33,452	15%	12	1,67,520	3,27,024
Amran	11,42,410	304	117	38%	2,34,215	21%	13	1,47,096	44,364
Dhamar	19,88,717	not available			3,39,132	17%	6	1,47,408	20,568
Marib	3,39,870	120	103	86%	1,20,815	36%	9	44,802	33,480
Sana'a	11,84,921	285	118	41%	2,78,542	24%	14	1,50,156	98,208

Management of malaria is included in the communicable diseases service availability. The HeRAMs report¹⁷ states more specifically that this involves diagnosis of suspected cases with RDTs, treatment of positive cases on detection, with referral of suspected cases, and follow up. This needs to be available at all levels of the health system (HU/HC/DH) but where communicable disease services are no longer fully available, or available at all, there will be a heavy impact on malaria case management service quality and accessibility.

The break down in functioning of health care services at such a wide scale across most governorates has other direct impacts on malaria. The disease can progress from initial infection to clinical disease within a few days. Once the first clinical symptoms appear, a patient may deteriorate very rapidly. If they are unable to access a health worker capable of providing a confirmatory diagnosis and correct ACT treatment during the time in which the disease presents itself as uncomplicated malaria, it will quickly progress to severe disease symptoms. Failure to diagnose malaria at an early stage and treat the

uncomplicated disease due to lack of access or health facility functionality, leads to critical delays whilst a patient travels in search of alternative health services. Delays of even a day, in the case of small children and immunocompromised patients, can lead to cases becoming severe. Severe malaria is more complex to treat requiring more complex treatment protocols and ongoing nursing care. When functionality of health services is compromised at all levels (including the inpatient care facilities needed for severe malaria management), as it now is in these four governorates (Sa'ada, Hajjah, Al Hudaydah and Taizz) and beyond, the chances of severe cases receiving adequate care has been severely diminished and death rates for malaria will have risen significantly.

The recommendation section of this report proposes practical solutions to improve access to effective malaria case management services and to mitigate the impact of malaria on communities until access to services can be improved, or during early stage epidemics.

INTERACTIONS OF MALARIA RISK FACTORS

SECURITY AND ACCESS

The ongoing conflict has had widespread effects on the Yemeni population across a number of different sectors. Food insecurity is vast; not only concerning issues of access and supply, but with shortage in food too. This is owed to the fact that many conflicts are occurring around areas of food distribution, such as ports. The health sector has similarly been subject to severe implications on its functionality, both direct and indirect, as a consequence of the ongoing conflict. This section will explore the issues concerning access prior to addressing the varying levels of services available once accessed.

SECURITY CONTEXT

As previously stated 14.8 million people lack access to basic healthcare. This is not evenly distributed across the population as it is highly dependent on the security situation of various governorates and hotspots of violence. As seen on the map below, the areas to observe tend to lie along the borders between areas of control and highlighted contested cities. Taizz remains highly affected by violence and ongoing conflict as several front lines exist within the governorate, making it a particularly challenging

environment to operate in. Despite recent disputes in the Houthi controlled Khaled bin Al-Waleed military camp in the northwest of Taizz, and its continued active conflict, the boundary lines in the governorate remain unchanged. There has been a steady continuation of coalition bombing across the northern governorates and some slight decrease in clashes in Hajjah. Neither have restricted themselves to military sites, and civilians are thus caught up in the violence. Sa'ada has been noted to have been a civilian targeted area with an overall increase in coalition (cluster) bombing in May, currently making it the governorate with the most air raids on non-military targets.

The security situation in Sa'ada governorate could deteriorate as the Houthi-Saleh faction has been firing '*high profile*' missiles in the direction of Riyadh since last month (most recently: 20/05/2017 intercepted close to Riyadh), and the Saudi coalition might intensify military actions on Sa'ada. Ports hold particular significance as they are key in the control of flow and distribution of supplies. Thus, whilst Al Hudaydah is not shown as a contested area on the map below, it is understood that there is a planned coalition attack on the port's town. Al Hudaydah's sea port represents a logistical lifeline for the population, one that is currently living through an emerging food and cholera crisis. Vital cargo deliveries through the port have reduced by more than half since the start of the crisis. Strategically positioned with easily accessible routes to the north and south of the country, Al Hudaydah is also located south of Ras Isa, a floating terminal which exports oil produced from the Marib governorate fields – a location which has attracted US counter-terrorism operations in recent days. The pipeline from Marib to Ras Isa transports 125,000 barrels per day, making Al Hudaydah of strategic importance. This could fuel a coalition agreement on regaining power over the Houthi controlled port, and thus administer the green light on an attack.

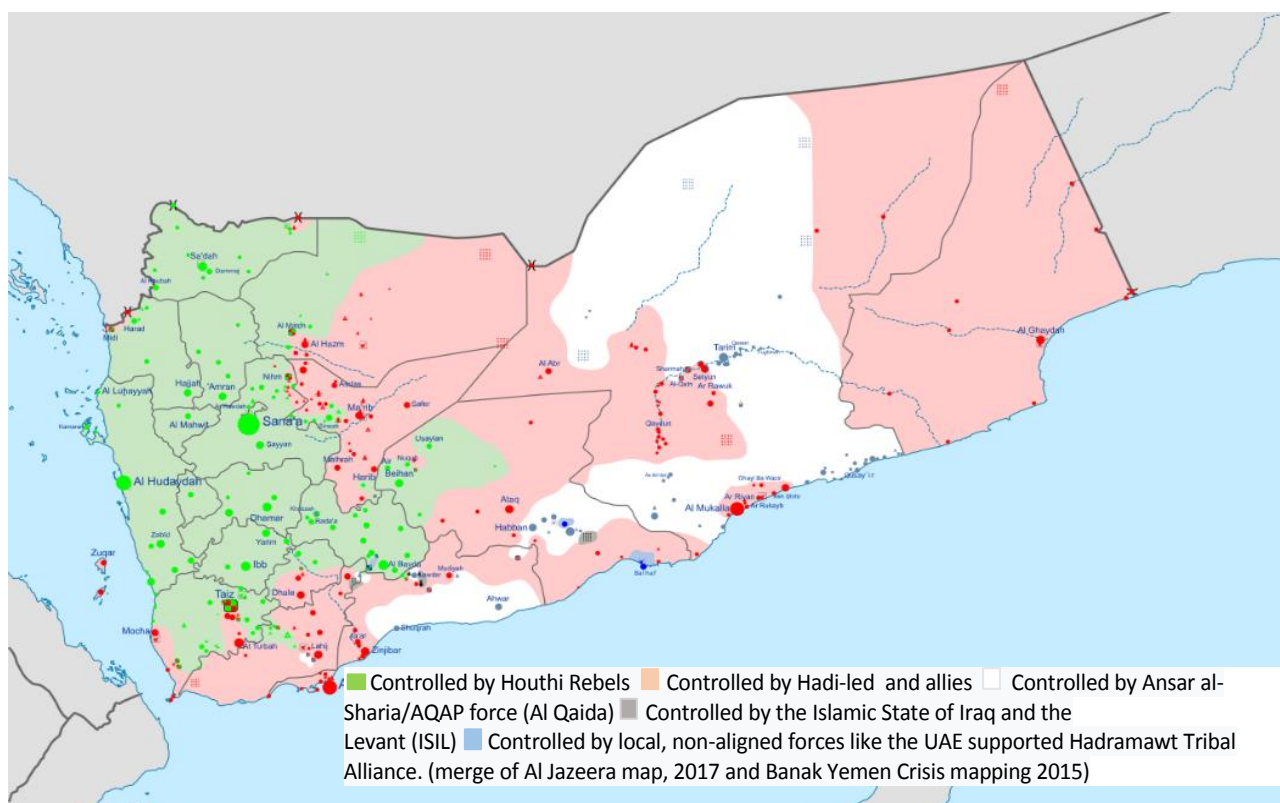
Saudi forces continue to press for an assault on Al Hudaydah, citing that the port is used by the Houthis and their allies to launch attacks in the Red Sea, smuggle weapons, and hijack aid shipments. Riyadh is working to counter any criticism that such military action could exacerbate the humanitarian crisis. There are reportedly divisions within the levels of Saudi-American governments over the efficacy of such action, but it remains unclear if the current US administration's approach to Yemen extends beyond the military track. Although all sides continue to pay

lip service to wanting to find a political solution to the situation they appear to be preparing for an impending escalation instead. Capturing the port would weaken the Houthi rebels considerably. Though it is not clear when the offensive will start, once it is initiated it is likely to be a fiercely contested confrontation. UN representatives are currently negotiating a ceasefire as a step towards peace negotiations planned for June. Pro-Hadi forces standby in Midi (Hajjah) and Mocha (Taiz), both neighbouring governorates.

Yemen's southern governorates are currently witnessing political unrest and insecurity after Aden's former governor, al-Zubaidi, announced the formation of a transitional council for the region.

This development was viewed by several analysts as a new step towards the process of separating South Yemen from the North. A move like this is not new in Southern Yemen as there exists an established Southern Movement calling for its partitioning. The movement has not stopped its activities towards this goal since its establishment in 2007, throughout the term of former president Saleh. Recent calls for separation have attracted the attention of several Southern leaders living outside Yemen. A separation of Southern Yemen would weaken the authority of the legitimate government in Yemen, as well as compromise the Saudi-led Arab coalition's operations, ultimately bolstering the chances of victory for the Houthis.

Figure 21: Map showing territory controlled by different groups in Yemen



Terrorist organizations like Al Qaeda (AQAP) thrive in this type of environment compiled of state collapse, growing sectarianism, shifting alliances, security vacuums and war economy (smuggling and trade)¹⁸. The evolution of AQAP (Al Qaeda in the Arabian Peninsula) into an insurgent force with the ambition and capacity to govern territory does not decrease the international risk posed by the group. AQ's long-game strategy, combined with the immediate benefits from Yemen's war, means that it, along with its local affiliates, will likely outlast the swift global rise of the Islamic State and its Yemeni subsidiary. They have pursued a far more aggressive approach that has triggered US special forces interventions comparable to those seen in Iraq and Afghanistan. The continuation of an increasingly fractured conflict greatly enhances AQAP's unprecedented ability to expand local support and amass financial and military resources. IS, with its more brutal tactics, has been less successful in gaining recruits and capturing territory. However, war has opened space for them to operate in places that have experienced sectarian-tinged violence, such as in the southern port city of Aden. There, the group has turned its sights on the Hadi government and local security personnel through assassinations and bombings that have indirectly benefited the Houthi rebel front by weakening its common enemies and repeatedly underscoring the lack of security in Aden, the government's temporary capital. Virtually all local and foreign fighting parties in Yemen claim to be enemies of AQAP and IS, yet all have contributed to their rise.

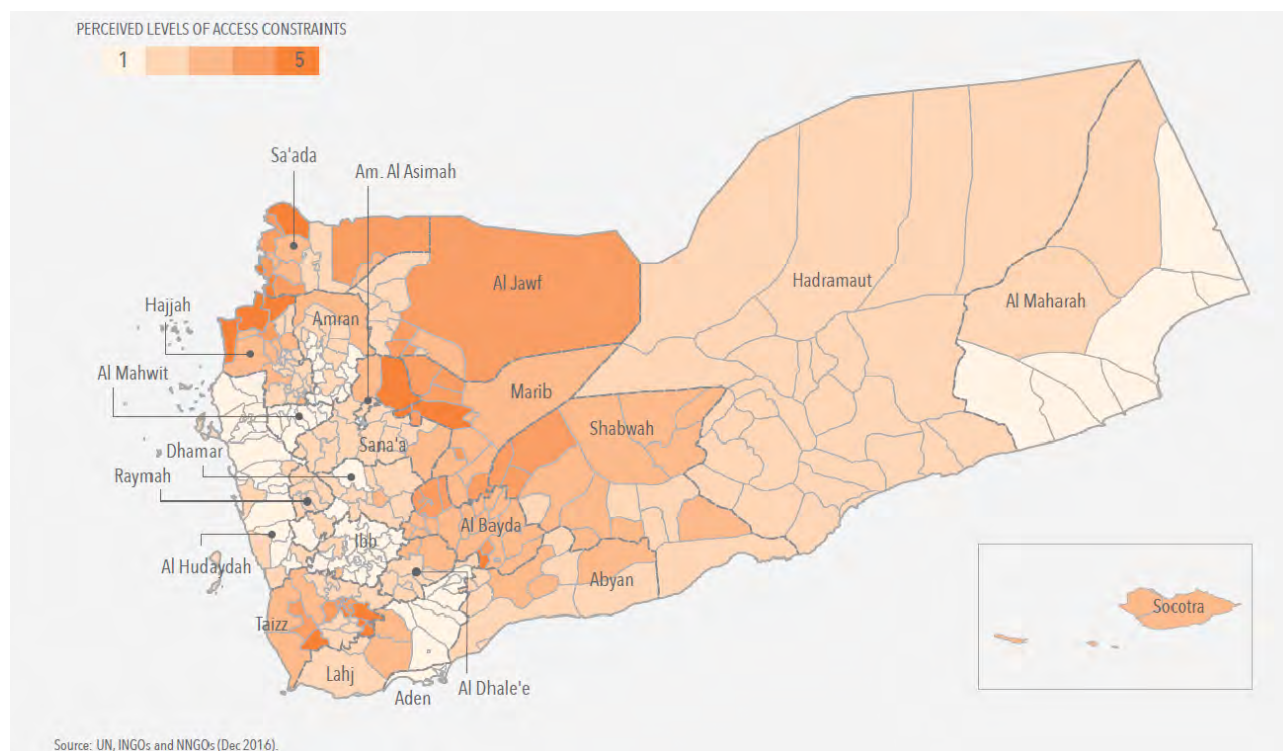
HUMANITARIAN ASSISTANCE/ACCESS

Factors affecting humanitarian access in Yemen are diverse and highly contextual, ranging from geographic challenges to poor infrastructure and conflict-related insecurity. Impediments to humanitarian access reported by humanitarian partners in 2016 have generally fallen under three broad categories: bureaucratic impediments, interference attempting to influence humanitarian operations, and security constraints as a result of armed conflict. Bureaucratic impediments such as visa processing and mission clearances, as well as local interference or attempted interference in the delivery of assistance, are by far the most significant reported constraints. Humanitarian partners estimated the severity of access constraints in all 333 districts using a five-point scale ranging from accessible to extremely difficult to access. Findings show that out of the 333 districts in Yemen's 22 governorates, the majority are perceived to be accessible to humanitarians.

Roughly 69% of districts in the country are either fully accessible or have relatively low access constraints according to humanitarian organizations that have been working in Yemen over the past year. Approximately 18% of districts are indicated to have '*medium access constraints*'. Only 13% of Yemen's districts (43 in total) reach the two highest levels of access constraints. The role of national partners and their increased ability to reach populations in need across Yemen was well noted in the discussions and analysis.

¹⁸ www.aljazeera.com/indepth/features/2017/05/benefits-weak-divided-yemen-170518125048895.html

Figure 22: Map showing access constraints, source: Source: UN, INGOs and NGOs, (Dec 2016)



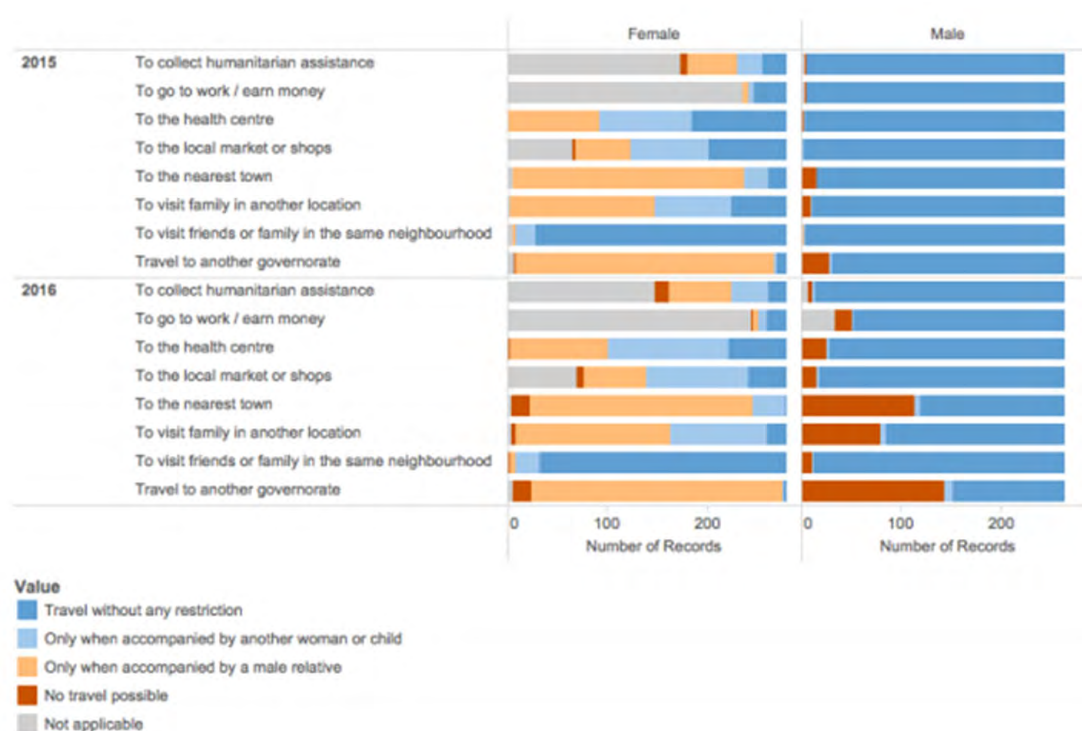
The 43 districts, gauged to be the most difficult to access, have a population of approximately 2.1 million people. This number also includes more than 289,000 IDPs (approx. 48,000 households) which are located in the conflict affected governorates of Taizz, Sa'ada, Marib, and Al Bayda, as well as in Hajjah and Al Jawf. Although Taizz Governorate is perceived to have more districts at the two highest levels of access constraints, the governorates of Marib and Sa'ada both registered higher percentages of districts in the 'high access constraints' or 'extremely difficult to access' categories¹⁹.

The ICRC have recently stated that 160 direct attacks have been carried out by warring factions on medical facilities and staff. Severely restricted access in and out of ports, particularly Al Hudaydah, is preventing medical supplies, food, and fuel from reaching their destinations. This has had grave consequences on the quantity and quality of health services available. It is generally understood that conflict has acted to reinforce and exacerbate horizontal inequalities along gender and ethnic lines (figure 23)²⁰.

¹⁹ www.who.int/emergencies/response-plans/2017/yemen/en/

²⁰ https://reliefweb.int/sites/reliefweb.int/files/resources/rr-yemen-gender-conflict-analysis-201016-en_0.pdf

Figure 23: showing freedom of movement pre-crisis compared to present by gender²⁰



Source: Household interviews

The humanitarian situation in Yemen has increased exposure of women and girls to gender-based violence (GBV), being especially true of female IDPs. Reports have documented a 70% increase in GBV related incidents in the first 6 months of conflict alone and should be an important consideration when discussing access to services, amongst other issues. A major restriction to accessing adequate healthcare is a lack of skilled female workers, without which women are often either reluctant or prohibited from using healthcare services, due to cultural norms. Female headed households are much more at risk of food insecurity given that they are often excluded from taking part in economic transactions.

Furthermore, Yemen has historically had issues with insufficient access to healthcare and basic education, particularly keenly felt by women and girls in rural and highland areas. Thus, alongside an increase in restricted movement for women and girls due to conflict, access to these services has become even more unattainable²⁰. Other marginalised groups are also at increased risk of violence and displacement, notably the Muhamasheen ('the Marginalized'). This minority group makes up a substantial proportion of the displaced population, especially in Hajjah and Taizz. They are subject to reduced access to income and education, and experience various discriminatory practices and attitudes that contribute to their precarious living conditions.

YEMEN
Access Constraints as of 20 February 2017

NOTE: THIS MAP SHOULD BE USED ONLY FOR INFORMATIONAL PURPOSES. IT DOES NOT CONSTITUTE AN OFFICIAL STATEMENT OF THE U.S. GOVERNMENT.

DISCLAIMER: The information contained on this map was collected as of the date of the information provided. It is possible that the location of the information may have changed since the date of the information was collected. The U.S. Government does not warrant the accuracy of the information. The U.S. Government is not responsible for any errors or omissions, or for any consequences arising from the use of the information. The U.S. Government is not responsible for any damages, including consequential damages, arising from the use of the information.

Legend:

- Red line:** Road Status
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Map Details:

- Geography:** The map shows the Republic of Yemen, bordered by Saudi Arabia to the north, Eritrea to the west, and Ethiopia and Djibouti to the southwest. The Red Sea is to the west, and the Gulf of Aden is to the south.
- Infrastructure:** Major roads are shown in various colors (red, yellow, green, blue, black) indicating their status. Key cities like Sana'a, Aden, Hodeidah, and Al Hudaydah are marked. The Bab el Mandeb Strait is shown at the southern tip.
- Legend:** A detailed legend on the right side of the map explains the symbols used for road status, road types, and other features. It includes a table for road status and a list of road types.
- Scale and Orientation:** A scale bar at the bottom right indicates distances in kilometers (0 to 100). A north arrow is also present.
- Disclaimer:** A note at the bottom right states: "Distances might not be accurate during rainy season."

Deteriorating security ramps up the risk of infection with malaria and other insect borne diseases amongst the 3.3 million people displaced from their homes, as living in temporary shelter usually increases exposure to infective bites. Al Hudaydah has an IDP population of over 100,000 people, and this is likely to increase the burden of malaria in 2017, compared to 2016. Access to malaria control services at health facility level, when most needed, has been severely reduced in all four priority governorates, by a combination of security related impacts, closed or damage health facilities, stock outs and reduced staffing. Access to effective treatment is further reduced by cultural and security limitations on women traveling alone. Likewise, insecurity reduces access of teams to reach affected communities, and to deliver prevention campaigns, and reduces the access of communities to teams distributing commodities at fixed point distribution sites. Unfortunately, the security situation is very fluid and access to any given area changes as conflict fronts move. This has significant implications investments designed to increase access to malaria case management services, and the recommendations section suggests some realistic solutions to this.

²¹ http://reliefweb.int/sites/reliefweb.int/files/resources/yem_op_supplyaccess_a3l_20170313.pdf

FOOD INSECURITY AND MALNUTRITION

Due to the scale and far reaching effects of a growing crisis of nutrition, food insecurity and resultant malnutrition is the story that has rightly grabbed much of the media and donor attention in Yemen. Malnutrition is a complex issue and should therefore not be seen in isolation. When considering its interactions with communicable

diseases, particularly malaria, we must understand how malnutrition compounds and intensifies healthcare and disease control needs. As stated in the recent ACAPS briefing note on Yemen: Food Security and Nutrition: *'food insecurity and malnutrition increases susceptibility to diseases and infections, and the health sector is ill-equipped to manage disease outbreaks'*²².

Figure 25: Maps above show current (left) and expected (right) status of food security by IPCC classification. The left hand map shows three out of the four priority governorates at risk of malaria have reached IPCC level 4 (emergency) with the final governorate (Al Hudaydah) expected to reach emergency status in the next four months.

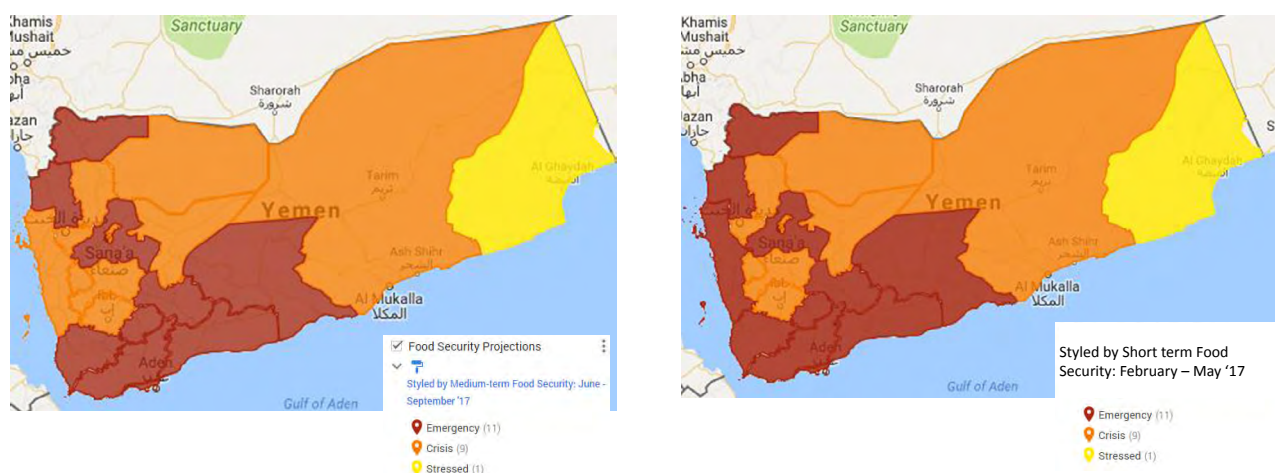


Figure 25 represents the varying severity of food insecurity across the country separated by governorate. **In Al Hudaydah, 25% of the population are at IPC level 4, Taizz 35%, and Hajjah and Sa'ada are both at 45%. These are all priority governorates for malaria transmission.**

MALARIA AND MALNUTRITION

The current food crisis has left the population increasingly vulnerable and high levels of severe acute malnutrition (SAM) are occurring and anticipated to increase. Patients that are suffering from severe malnutrition and malaria infection are the most complex to diagnose and treat, and will suffer the highest risk of death. Case management of these patients is complicated as patients suffering from SAM and malaria often do not display obvious symptoms (e.g. fever). These are symptoms that only surface once weight gain has been achieved. Consequently, these cases are more likely to start treatment late and deteriorate into severe malaria, greatly increasing the risk of death. Children under

5 are at the greatest risk of malaria related death. When faced with food insecurity they are most likely to experience malnutrition which, without adequate timely intervention, can deteriorate to SAM. Proactive screening of malaria for children suffering from SAM is essential, even if they are not displaying any symptoms, in order to ensure that no cases are missed.

Treatment and case management of individuals suffering from both malnutrition and malaria infection is more complicated in this situation. Severe malnutrition causes the microvilli that line the stomach to collapse or fold, reducing the surface area of the stomach and causing poor absorption (by as much as 50%) of drugs and nutrients. Artemisinin-based combination therapy (ACT), the first line treatment for malaria infection, relies on

²² www.acaps.org/country/yemen/special-reports#container-864

adequate digestive absorption to be effective. This effect of malnutrition has potential to significantly complicate malaria prognosis making the management of these cases even more complex, slow and more likely to lead to severe disease and death. In many cases effective treatment can only be achieved through the use of non-oral medication, particularly injectable or rectal artesunate being more readily available in health facilities of all levels. Rectal artesunate is vital as an alternative to oral medication in situations where health worker skills are low and use of injectables may be restricted. These medications are also recommended in WHO guidelines for severe malaria management and malaria control in humanitarian emergencies.

SAM/MAM DATA FROM NUTRITION CLUSTER (2017)

Table 13 shows the number of targeted children suffering from Severe Acute Malnutrition and Moderate Acute Malnutrition separated by governorate and district in the four priority governorates identified for malaria. Should Child Malaria Prophylaxis be used as an intervention to be distributed alongside feeding programmes, this information provides an estimate of current reach of the primary target group in these four governorates.

Governorate	District	# of children (aged 6-59 months) treated for severe acute malnutrition (SAM)					# of children (aged 6-59 months) treated for moderate acute malnutrition (MAM)				
		Total targeted beneficiaries	Reached beneficiaries				Total targeted beneficiaries	Reached beneficiaries			
			Total	Boys	Girls	% reach		Total	Boys	Girls	% reach
Al Hudaydah	Ad Dahi	2,351	123	145	268	11%	4,169	-	-	-	0%
Al Hudaydah	Ad Durayhimi	2,307	91	136	227	10%	4,092	1,222	1,208	2,430	59%
Al Hudaydah	Al Garrahi	3,841	710	942	1,652	43%	6,813	182	216	398	6%
Al Hudaydah	Al Hajjaylah	433	34	64	98	23%	769	216	214	430	56%
Al Hudaydah	Al Hali	6,984	259	394	653	9%	12,388	371	435	806	7%
Al Hudaydah	Al Hawak	6,330	246	286	532	8%	11,228	-	-	-	0%
Al Hudaydah	Al Khawkhah	1,463	91	98	189	13%	2,595	83	116	199	8%
Al Hudaydah	Al Mansuriyah	1,892	131	121	252	13%	3,356	551	550	1,101	33%
Al Hudaydah	Al Marawi'ah	5,490	357	457	814	15%	9,737	1,678	1,740	3,418	35%
Al Hudaydah	Al Mighlaf	1,712	79	99	178	10%	3,037	224	199	423	14%
Al Hudaydah	Al Mina	3,537	51	77	128	4%	6,273	-	-	-	0%
Al Hudaydah	Al Munirah	1,631	72	89	161	10%	2,892	31	18	49	2%
Al Hudaydah	Al Qanawis	3,233	236	300	536	17%	5,735	584	548	1,132	20%
Al Hudaydah	Alluheyah	4,712	275	374	649	14%	8,357	1,022	1,133	2,155	26%
Al Hudaydah	As Salif	219	2	3	5	2%	389	-	-	-	0%
Al Hudaydah	As Sukhnah	2,501	109	105	214	9%	4,436	887	896	1,783	40%
Al Hudaydah	At Tuhayat	2,862	214	256	470	16%	5,076	-	-	-	0%
Al Hudaydah	Az Zaydiyah	4,129	376	560	936	23%	7,324	-	-	-	0%
Al Hudaydah	Az Zuhrah	6,864	994	1,293	2,287	33%	12,174	487	570	1,057	9%
Al Hudaydah	Bajil	6,943	75	122	197	3%	12,315	34	62	96	1%
Al Hudaydah	Bayt Al Faqiah	10,148	607	715	1,322	13%	17,999	188	202	390	2%
Al Hudaydah	Bura	1,925	19	7	26	1%	3,414	242	287	529	15%
Al Hudaydah	Hays	1,956	645	853	1,498	77%	3,469	75	105	180	5%
Al Hudaydah	Jabal Ra's	1,922	172	205	377	20%	3,409	48	55	103	3%
Al Hudaydah	Kamaran	96	16	14	30	31%	170	-	-	-	0%
Al Hudaydah	Zabid	6,623	490	579	1,069	16%	11,747	-	-	-	0%
District Totals		92,103	6,474	8,294	14,768	17%	163,361	8,125	8,554	16,679	13%
Hajjah	Abs	3,413	194	262	456	13%	10,969	62	85	147	1%
Hajjah	Aflah Al Yaman	795	31	37	68	9%	2,554	69	63	132	5%
Hajjah	Aflah Ash Shawm	236	24	33	57	24%	1,918	73	77	150	8%
Hajjah	Al Jamimah	193	63	71	134	69%	1,569	495	460	955	61%
Hajjah	Al Maghrabah	250	30	25	55	22%	2,033	260	269	529	26%
Hajjah	Al Mahabishah	939	73	141	214	23%	3,019	86	124	210	7%
Hajjah	Al Miftah	144	11	24	35	24%	1,168	63	103	166	14%
Hajjah	Ash Shaghadirah	888	68	79	147	17%	2,854	215	261	476	17%
Hajjah	Ash Shahil	126	15	30	45	36%	1,022	289	345	634	62%
Hajjah	Aslem	1,050	65	88	153	15%	3,377	89	115	204	6%
Hajjah	Bakil Al Mir	644	27	26	53	8%	2,069	112	82	194	9%
Hajjah	Bani Al Awam	207	12	10	22	11%	1,684	251	243	494	29%
Hajjah	Bani Qa'is	1,018	106	105	211	21%	3,273	696	739	1,435	44%
Hajjah	Hajjah	469	17	26	43	9%	1,507	320	256	576	38%

Governorate	District	# of children (aged 6-59 months) treated for severe acute malnutrition (SAM)					# of children (aged 6-59 months) treated for moderate acute malnutrition (MAM)				
		Total targeted beneficiaries	Reached beneficiaries				Total targeted beneficiaries	Reached beneficiaries			
			Total	Boys	Girls	Total		Total	Boys	Girls	Total
Hajjah	Hajjah City	219	67	87	154	70%	1,781	95	118	213	12%
Hajjah	Haradh	-	-	-	-	0%	-	-	-	-	0%
Hajjah	Hayran	401	125	177	302	75%	1,288	51	59	110	9%
Hajjah	Khayran Al Muharraq	1,467	125	171	296	20%	4,716	457	500	957	20%
Hajjah	Ku'aydinah	1,322	314	401	715	54%	4,248	289	318	607	14%
Hajjah	Kuhlan Affar	157	29	49	78	50%	1,276	95	116	211	17%
Hajjah	Kuhlan Ash Sharaf	210	35	29	64	30%	1,708	125	173	298	17%
Hajjah	Kushar	1,643	192	228	420	26%	5,281	362	460	822	16%
Hajjah	Mabyan	972	34	29	63	6%	3,125	76	107	183	6%
Hajjah	Midi	-	-	-	-	0%	-	-	-	-	0%
Hajjah	Mustaba	1,028	69	68	137	13%	3,306	268	296	564	17%
Hajjah	Najrah	683	23	41	64	9%	2,195	204	177	381	17%
Hajjah	Qafil Shamer	952	143	198	341	36%	3,060	308	302	610	20%
Hajjah	Qarah	133	37	33	70	53%	1,079	24	19	43	4%
Hajjah	Sharas	67	12	11	23	34%	545	111	145	256	47%
Hajjah	Wadhrah	231	14	24	38	16%	742	51	85	136	18%
Hajjah	Washhah	1,422	96	150	246	17%	4,571	371	484	855	19%
District Totals		21,279	2,051	2,653	4,704	26%	77,935	5,967	6,581	12,548	19%
Sa'ada	Al Dhaher	-	12	5	17	0%	-	-	-	-	0%
Sa'ada	Al Hashwah	430	23	31	54	13%	614	16	20	36	6%
Sa'ada	As Safra	1,433	65	68	133	9%	2,047	67	83	150	7%
Sa'ada	Baqim	413	38	32	70	17%	590	-	-	-	0%
Sa'ada	Ghamr	344	12	13	25	7%	1,060	-	-	-	0%
Sa'ada	Haydan	663	125	184	309	47%	2,045	463	521	984	48%
Sa'ada	Kitaf wa Al Boqe'e	931	15	21	36	4%	1,329	60	89	149	11%
Sa'ada	Majz	1,263	60	54	114	9%	3,892	-	-	-	0%
Sa'ada	Monabbih	922	59	48	107	12%	2,841	-	-	-	0%
Sa'ada	Qatabir	413	-	-	-	0%	1,273	-	-	-	0%
Sa'ada	Razih	546	98	100	198	36%	1,683	-	-	-	0%
Sa'ada	Sa'ada	615	105	126	231	38%	878	-	-	-	0%
Sa'ada	Sahar	3,678	102	129	231	6%	5,254	283	312	595	11%
Sa'ada	Saqayn	1,044	47	75	122	12%	3,217	303	255	558	17%
Sa'ada	Shada'a	164	9	7	16	10%	235	-	-	-	0%
District Totals		12,858	770	893	1,663	15%	26,960	1,192	1,280	2,472	7%
Taizz	Al Mukha	1,277	124	141	265	21%	3,407	-	-	-	0%
Taizz	Al Ma'afer	799	75	118	193	24%	4,600	-	-	-	0%
Taizz	Al Mawasit	823	80	117	197	24%	4,738	86	83	169	4%
Taizz	Al Misrakh	574	111	144	255	44%	3,307	60	59	119	4%
Taizz	Al Mudhaffar	898	56	67	123	14%	5,098	-	-	-	0%
Taizz	Al Qahirah	489	61	69	130	27%	2,775	-	-	-	0%
Taizz	Al Wazi'iyah	-	36	28	64	0%	-	-	-	-	0%
Taizz	As Silw	348	3	5	8	2%	2,002	31	35	66	3%
Taizz	Ash Shamayatayn	1,233	298	397	695	56%	7,101	-	-	-	0%
Taizz	At Ta'iziyah	1,190	306	404	710	60%	6,853	609	661	1,270	19%
Taizz	Dhubab	-	-	-	-	0%	-	-	-	-	0%
Taizz	Dimnat Khadir	957	38	54	92	10%	5,513	306	402	708	13%
Taizz	Hayfan	707	-	-	-	0%	4,069	-	-	-	0%
Taizz	Jabal Habashy	814	29	41	70	9%	4,685	-	-	-	0%
Taizz	Maqbanah	4,495	508	572	1,080	24%	11,994	946	1,057	2,003	17%
Taizz	Mashra'a Wa Hadnan	186	24	28	52	28%	1,069	-	-	-	0%
Taizz	Mawiyah	2,927	179	243	422	14%	7,811	170	212	382	5%
Taizz	Mawza	869	46	67	113	13%	2,320	-	-	-	0%
Taizz	Sabir Al Mawadim	761	185	227	412	54%	4,385	46	56	102	2%
Taizz	Salh	457	-	-	-	0%	2,596	-	-	-	0%
Taizz	Sama	294	63	89	152	52%	1,695	45	47	92	5%
Taizz	Shara'b Ar Rawnah	1,023	143	213	356	35%	5,891	128	142	270	5%
Taizz	Shara'b As Salam	787	37	43	80	10%	4,533	-	-	-	0%
District totals		21,907	2,402	3,067	5,469	23%	96,442	2,427	2,754	5,181	3%

Of note, throughout the four governorates that exhibit the highest burden of disease, Table 13 shows that the proportion of female children attending treatment for severe and moderate was significantly greater than the male children. Given that females are already disadvantaged in terms of access to health services, compared to males, it is reasonable to assume that female children will also have an arguably greater risk of developing severe malaria. The risk of developing both severe

malaria and malnutrition (moderate or severe) is therefore slightly greater for female children than male children. These cases need to be identified as early as possible within their communities and treated or death rates will be higher amongst this group. Table 14 shows the totals reached and treated in the four governorates with the highest burden of disease from January – October 2016, by governorate²³.

Table 14: Number of beneficiaries reached with nutritional services, January – October 2016

Governorate	SAM Treated	MAM Treated	Pregnant/Lactating treated	Received Blanket Supplementary Feeding
Al Hudaydah:	67,880	105,512	76,528	34,698
Hajjah	22,653	51,685	24,940	20,415
Sa'ada	20,408	5,662	3,340	1,202
Taizz	23,406	22,490	20,653	25,243

Yemen has 2,929 outpatient therapeutic programmes, 1,847 supplementary therapeutic programmes, 45 static clinics, and 114 mobile clinics specifically equipped to address these needs. During this same time period, **3,103 Health Workers and 4,670 Community Volunteers have been trained across the country. These HWs and CHVs provide a vital resource not just for nutritional responses to the escalating famine conditions in the priority**

governorates, but also as a potential mechanism now for significantly expanding access to primary level health care, including malaria diagnosis and treatment, as well as delivery of malaria prevention activities. Figure 26 and Table 15 Identifies the organizations that currently have active teams and programmes in each area of the nutritional response within each of the priority governorates, in terms of disease burden.

²³ www.humanitarianresponse.info/system/files/documents/files/nutrition_cluster_performance_jan-dec_2016.pdf

Figure 26: 4W map from Nutrition cluster, May 2017

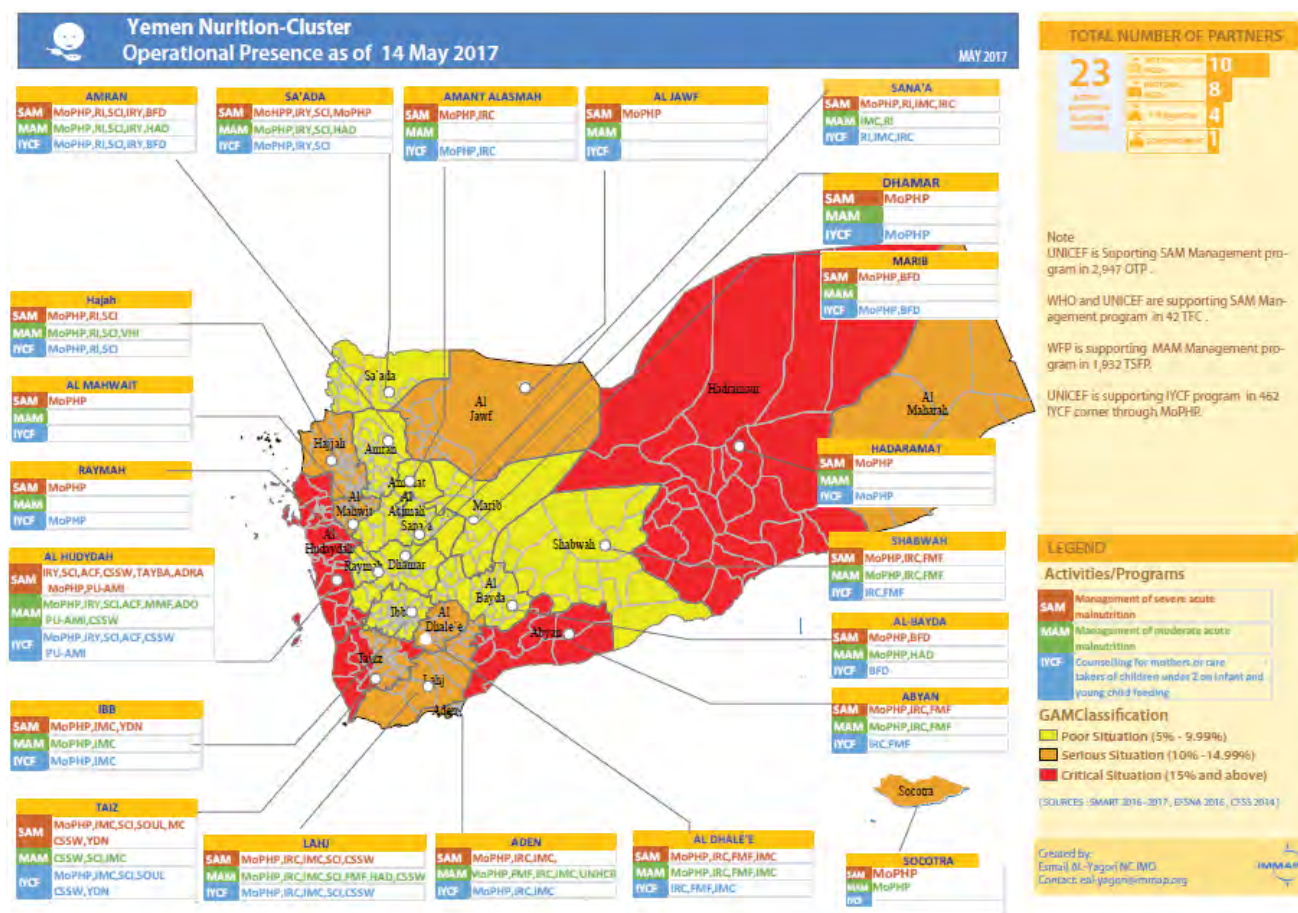


Table 15: Information taken from 4W provided by Nutrition cluster (Annex 5)

SAM				MAM				IYCF			
Sa'ada	Hajjah	Al Hundaydah	Taizz	Sa'ada	Hajjah	Al Hundaydah	Taizz	Sa'ada	Hajjah	Al Hundaydah	Taizz
MoPHP	MoPHP	IRY	MoPHP	MoPHP	MoPHP	MoPHP	CSSW	MoPHP	MoPHP	MoPHP	MoPHP
IRY	RI	SCI	IMC	IRY	RI	IRY	SCI	IRY	RI	IRY	IMC
SCI	SCI	ACF	SCI	SCI	SCI	ACF	IMC	SCI	SCI	SCI	SCI
MoPHP		CSSW	MC	HADO	VHI	MMF				ACF	SOUL
		TAYBA				ADO				CSSW	CSSW
		ADRA				PU-AMI				PU-AMI	YDN
		MoPHP				CSSW					
		PU-AMI									

This information can be seen represented on the map below (figure 27) from the Nutrition cluster, highlighting Al Hudaydah as being in a critical situation. Taizz and Hajjah remain in a serious situation, and Sa'ada in a poor situation. This is reflected relatively well in the responses, shown on the maps below, where health facilities have had to be prepared in order to manage this need.

It should be noted that if the southwestern region of Sa'ada is highlighted as a priority region for malaria control, but here, feeding programmes may not be an appropriate distribution point for medical interventions, given the low coverage of OTP/SFPs (figures 27 and 28)²⁴ as the coverage of these is low. It would appear to be a much more effective solution

24 <https://reliefweb.int/map/yemen/yemen-nutrition-cluster-district-implementation-otps-march-2017>
<https://reliefweb.int/map/yemen/yemen-nutrition-cluster-district-implementation-tsfs-march-2017>

for both Hajjah and Al Hudaydah, where coverage of OTPs is widespread. Taizz is somewhat patchy, but offers Reasonable coverage.

TSFP coverage is naturally lower than for OTPs, and often overlaps with the same site or health facility. The TSFP will be managing the

most complex cases of malnutrition, including those with uncomplicated malaria, and severe malaria, and are in need of additional support, as management of these cases is complex and challenging and death rates associated with these cases can be as high as 40% as discussed in earlier sections.

Figure 27: Distribution of OTPs, March 2017

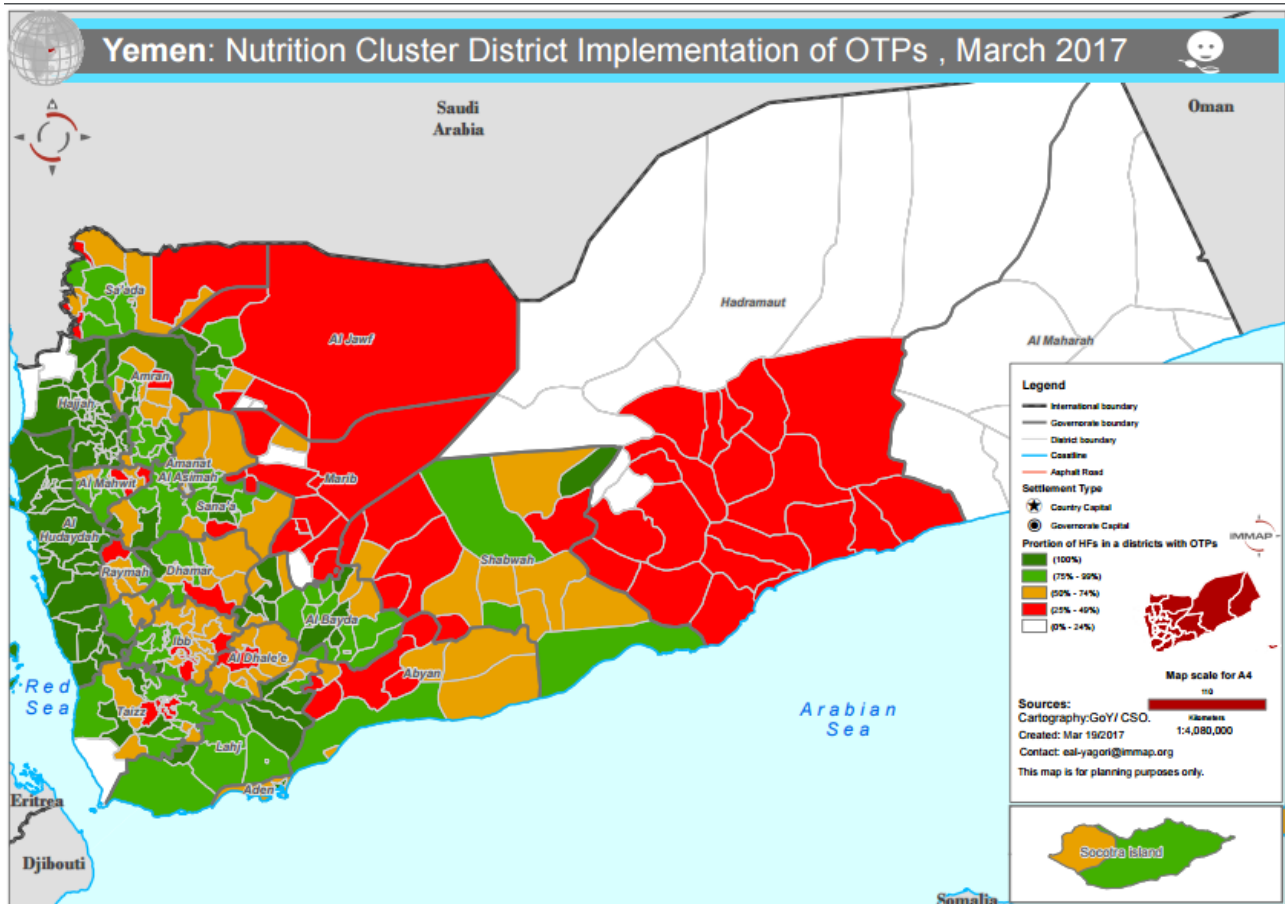
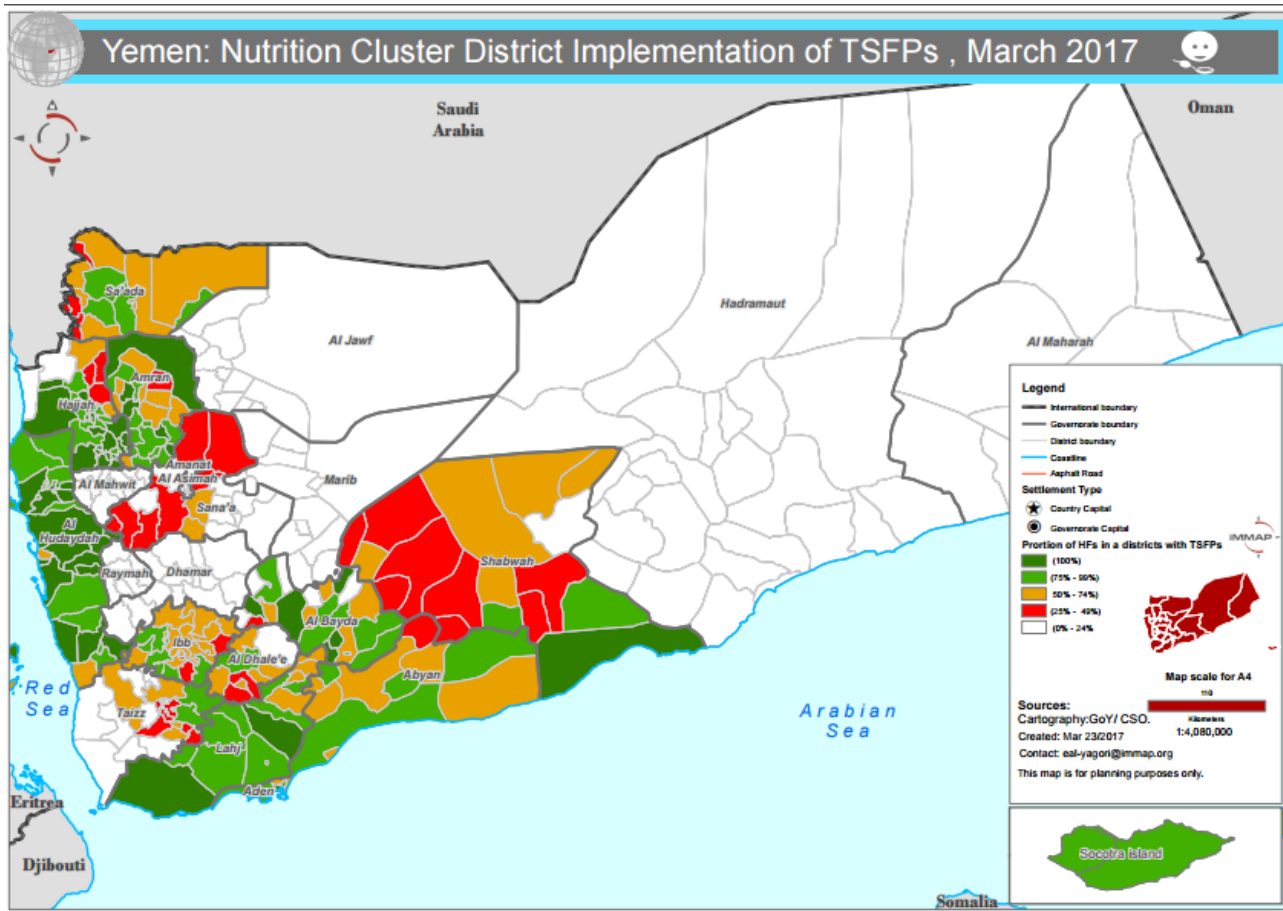


Figure 28: Distribution of TSFPs, March 2017



DISPLACEMENT

The population centres of Yemen are concentrated just inland from the western coast, along the Tehama region. This area is known to be the most fertile area and runs from >1000 m above sea level. Malaria transmission risk varies with altitude (as discussed earlier) but is largely moderate to low in the population centres, and the transmission season extends through winter into early summer. In contrast, the low altitude coastal areas (0-400 m above sea level) are those at risk of highest malaria transmission, with transmission from October to March. Population displacement between these very different malaria transmission risk settings is a major concern and a very real issue currently.

In October 2016 approximately 2.2 million individuals were estimated to be internally displaced, and numbers are now thought to have reached 3.3 million²⁵ since the conflict began. The latest task force on population movement (TFPM),

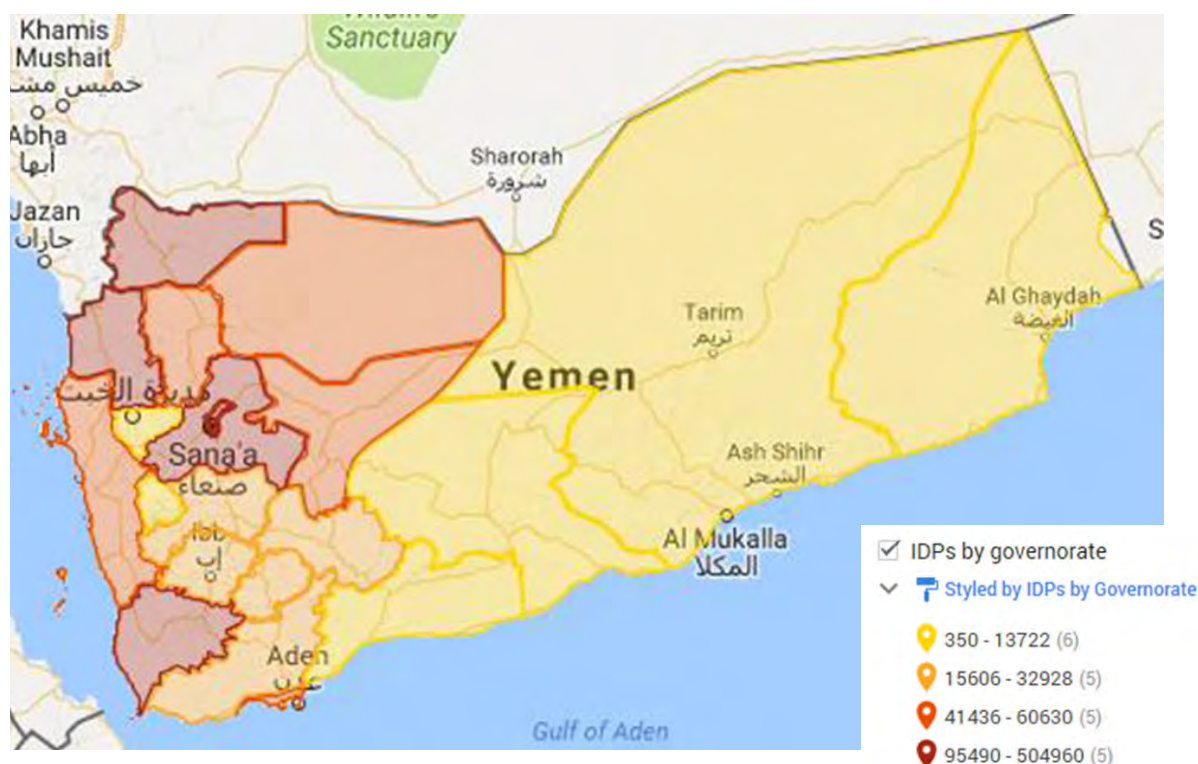
at the time of writing, has records of 1,991,340 IDPs and a further 1,048,896 returnees across 21 and 19 governorates respectively (Figure 29) (Annex 6). More than 10% of Yemen's pre-conflict population have now been subject to shock displacement and, as a result, require greater levels of assistance and protection²⁶.

The most pressing needs of IDPs interviewed (TFPM), were food (75%) access to income (8%), and shelter/housing (6%)²⁶. **Malnutrition, diarrhoeal diseases, and malaria were the most commonly reported health concerns of IDPs.** Lack of stable and secure accommodation and income leaves them both more at risk of exposure to insect bites and more vulnerable to food insecurity. A total of 30% of IDPs reported that access to health facilities was non-existent. Just 27% reported access to health units, and 16% said they had access to private clinics²⁶.

²⁵ www.iom.int/news/humanitarian-catastrophe-looms-yemen-over-33-million-displaced-crisis-began

²⁶ https://reliefweb.int/sites/reliefweb.int/files/resources/draft_tfpm_13th_report_feb2017_v4.pdf

Figure 29: Map shows severity of displacement taken from TFPM raw data (Annex 6), to show burden by governorate



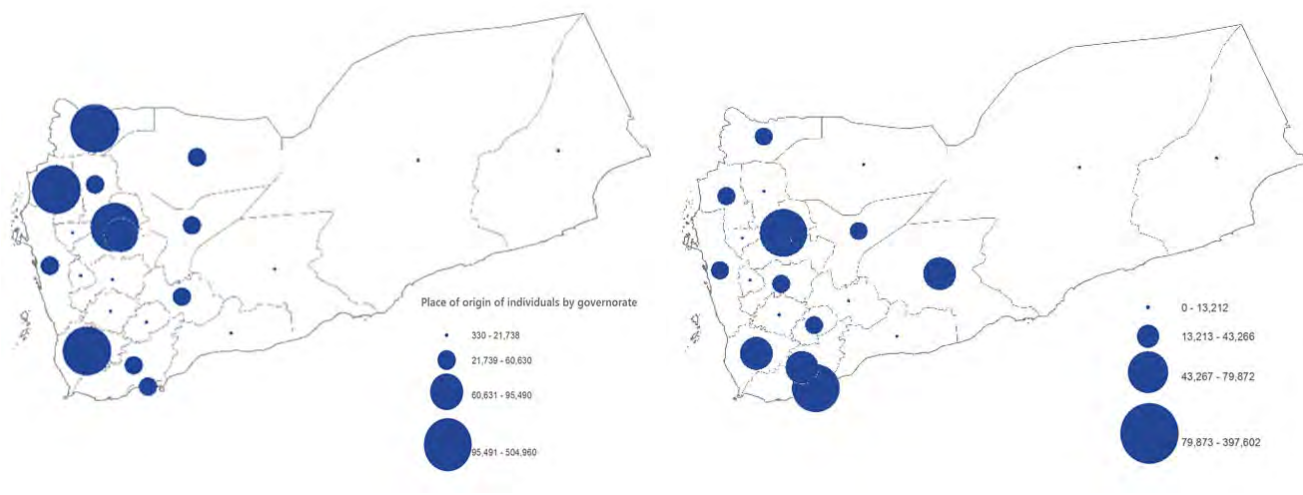
For IDPs who had returned to their place of origin, the primary reasons given for returning included: lack of access to sustainable income (46%), and lack of access to basic services (28%) in the place where they had been displaced to. This demonstrates that IDPs are normally the most vulnerable, just when their need are greatest. Levels of displacement have plateaued in recent months but numbers remain high with 'generalised violence and armed conflict' listed as the primary reason for displacement.

Fifty seven (57) % of IDPs are concentrated in just five governorates including Hajjah, Taizz, and 70% originate from four governorates associated with high levels of conflict (figure 34 and 35). Taizz accounts for 25%, Hajjah 19%, Amanat Al Asimah and Sa'ada 16% each of IDP origin locations. Forty two (42) % of IDPs have remained within their governorate of origin, whilst just 11% have remained in their district of origin. 84% of IDP households have now been displaced for more than a year, despite surveys showing that 81% intended to return to their place of origin within three months²⁷. Displacement feeds directly into being at higher risk of malaria transmission in Yemen for a number of reasons.

Displaced people are far more likely to be exposed to insect bites, have poor access to healthcare, and be at risk of food insecurity. IDPs coming from areas of low malaria transmission into areas of higher malaria transmission have little immunity to clinical malaria and these communities are the most at risk of experiencing epidemics when rains come, mosquito populations expand and disease transmission escalates. In these settings, IDPs are at higher risk of malaria infection, severe disease and death, compared to the host communities, if well nourished, will have some partial immunity to severe disease. These governorates most affected by IDPs (i.e. those from where they are displaced from, and those receiving and hosting them) have mixed height ranges of between 400 to 2,000 MASL thus exhibiting moderate to very low rates of malaria transmission, peaking through winter and into early summer.

²⁷ http://reliefweb.int/sites/reliefweb.int/files/resources/tfpm_multi-cluster_location_assessment_report.pdf

Figure 30: Maps from TFPM report (Annex 9) show governorates of origin and return respectively giving an idea of areas of greatest displacement

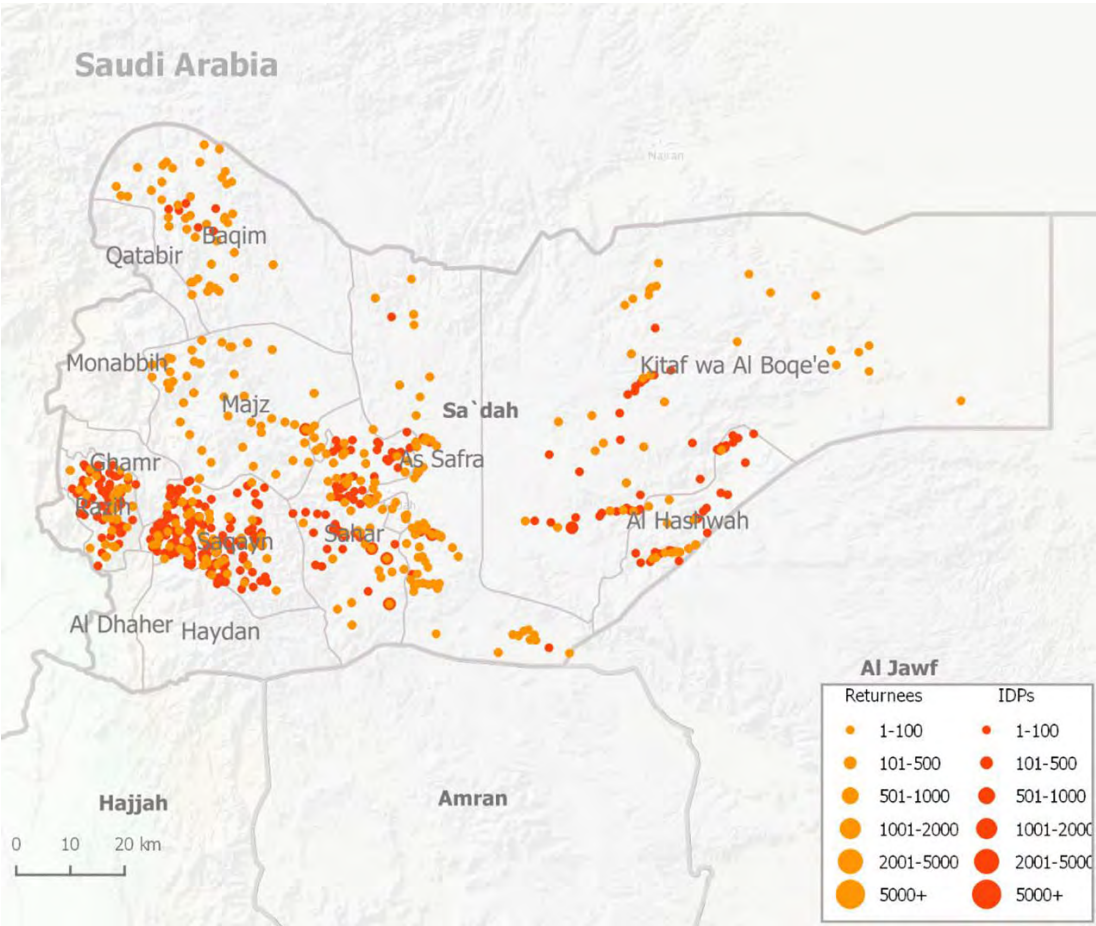


IDPs living in make shift settlements or recognized settlement centres, are likely to be the most at risk, compared to those sharing homes of host families. However, vulnerability of families hosting IDPs also increases in many circumstances, and should be protected along with their IDP families where ever possible. The IDP settings and risks for malaria are different in each of the priority governorates and are discussed below.

SA'ADA

Sa'ada has a population of 1.04 million people (source: Central Statistics Office's projections for 2016). The governorate consists of moderate to low (Strata 2, 3 and 4) malaria transmission zones. There are an estimated 17,005 IDP households, totalling 102,030 IDPs, dispersed across 980 locations in the governorate (Figure 30. More than 50% of these

Figure 30: Map taken from TFPM report to show IDP/returnee population distributions in Sa'ada (Annex 7)



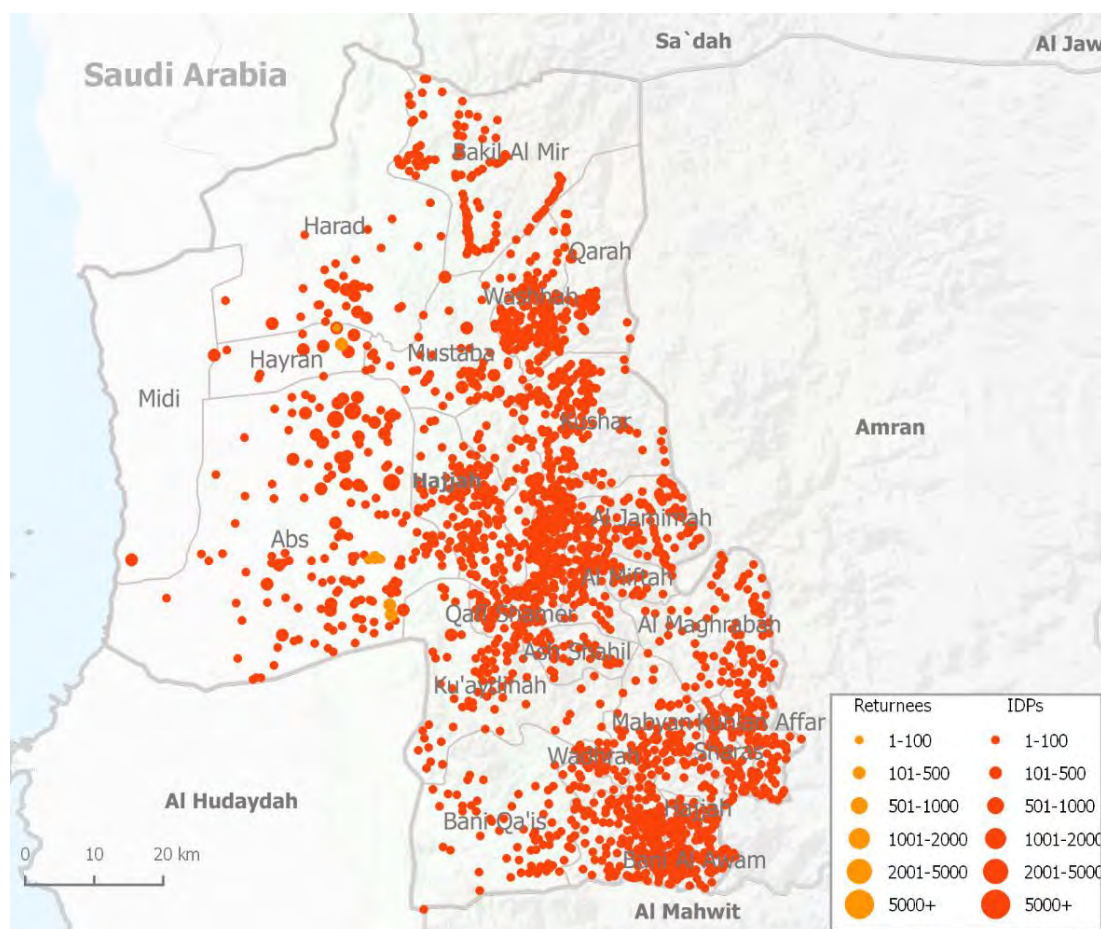
however, are concentrated in 2 districts to the southwest of the governorate; Sahar (4,956 IDP households) and Saquayn (3,903 IDP households). When taken in conjunction with the maps on malaria prevalence and transmission of *P. falciparum*, it is notable that these areas have some overlap with areas of greater disease risk, particularly Sahar. The majority of IDPs in Sa'ada are housed in either rented accommodation or with host families, likely to be established structures. This integrated trend of IDPs into local communities' houses underscores the necessity of simultaneously ensuring the preventative measures for both IDPs and host communities in the malaria endemic areas. To reach the surrounding host communities. Both the MIS survey and MPR show the main hotspot of disease transmission in Sa'ada to be along the western border of Saudi Arabia, where the population centre is the city of Suq Al Malahif, in Razih district. This town hosts 523 IDP households, and these should be protected with the town population.

HAJJAH

This governorate has a more mixed topography than Sa'ada, extending from higher ground right down to the coast. However, the majority of the original

population inhabits the regions of 1,000-2,000m above sea level. These regions will have a longer but lower risk transmission season, extending from the longer winter one into a short summer season. The population is approximately double that of Sa'ada yet hosts nearly four times the number of IDPs (420,516). **Almost a quarter of the IDPs are located in the district of Abs which reaches down to the coast. It is therefore in a higher risk strata of malaria transmission** and, dependent on the location of settlements, means that these IDPs are highly vulnerable to malaria, and should be protected during the winter season of peak transmission, together with the host communities. If people are displaced here from the higher altitude locations with lower malaria transmission, they will lack the partial immunity that protects local populations from outbreaks and **malaria epidemics may occur**. In this governorate there are far more 'settlements (groups of families) urban and rural' than Sa'ada as well as considerable numbers who are living in rented accommodation. Depending on the shelter type and settlement area, IRS or LLINs, and potentially larvicide, may prove most feasible and effective. This will need to be locally accessed where possible as part of detailed prevention planning stages.

Figure 31: TFPM Map showing IDP/returnee population distributions in Hajjah (Annex 7)

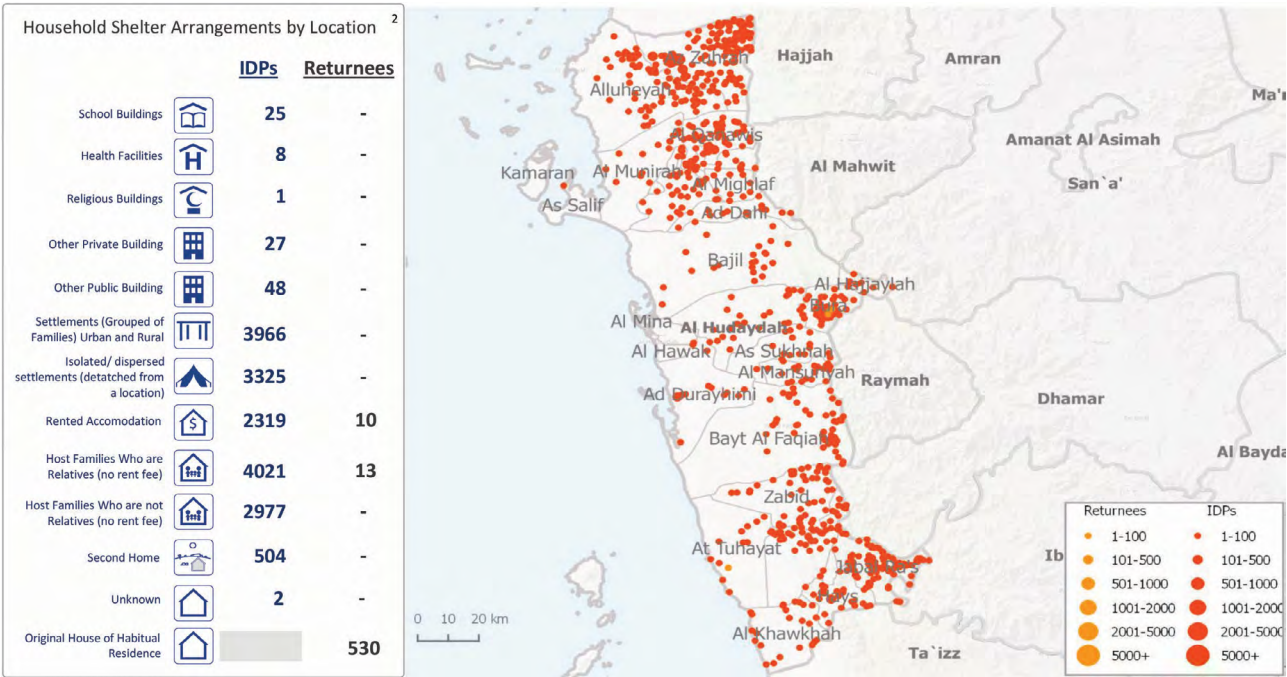


AL HUDAYAH

Runs along the western coast and of the governorate is low altitude, and has the highest malaria transmission risk of any governorate in Yemen. Consequently, the over 5 year old sectors of the host population have partial immunity to infection and should not be at risk of malaria epidemics. However, any communities displaced into this area, from the towns and communities in higher altitude areas, will be at risks of localized epidemics themselves, and all

IDP age groups will be at risk, and require protection and access to health services. This original population of 3.1 million has swelled by more than 100,000 IDPs since the conflict began (figure 32). The IDPs live in a variety of conditions, including approximately 7,000 IDPs living in settlements, where accommodation will be more exposed and conditions more adverse. The northern most district, bordering with Hajjah, is home to a further 6081 IDP households (36% of IDP).

Figure 32: Map and Shelter – TFPM- showing IDP/returnee population in Al Hudaydah (Annex 7)



Here, the malaria transmission season runs from October through until April, and given the very high burden of malaria this governorates population suffer, all host and IDP communities require good access to effective malaria prevention and health care services to ensure early diagnosis and treatment. Without these, death rates amongst young children in the host communities, and amongst IDP children to young adults, will be high.

TAIZZ

Out of the four priority governorates, Taizz has the highest population at 3.12 million, and an IDP population of 273,780. This governorate ought to have comparable malaria risk to Al Hudaydah, given it is also coastal, however, its population is much more concentrated in centres built in the areas of higher altitude where the risk of disease transmission is

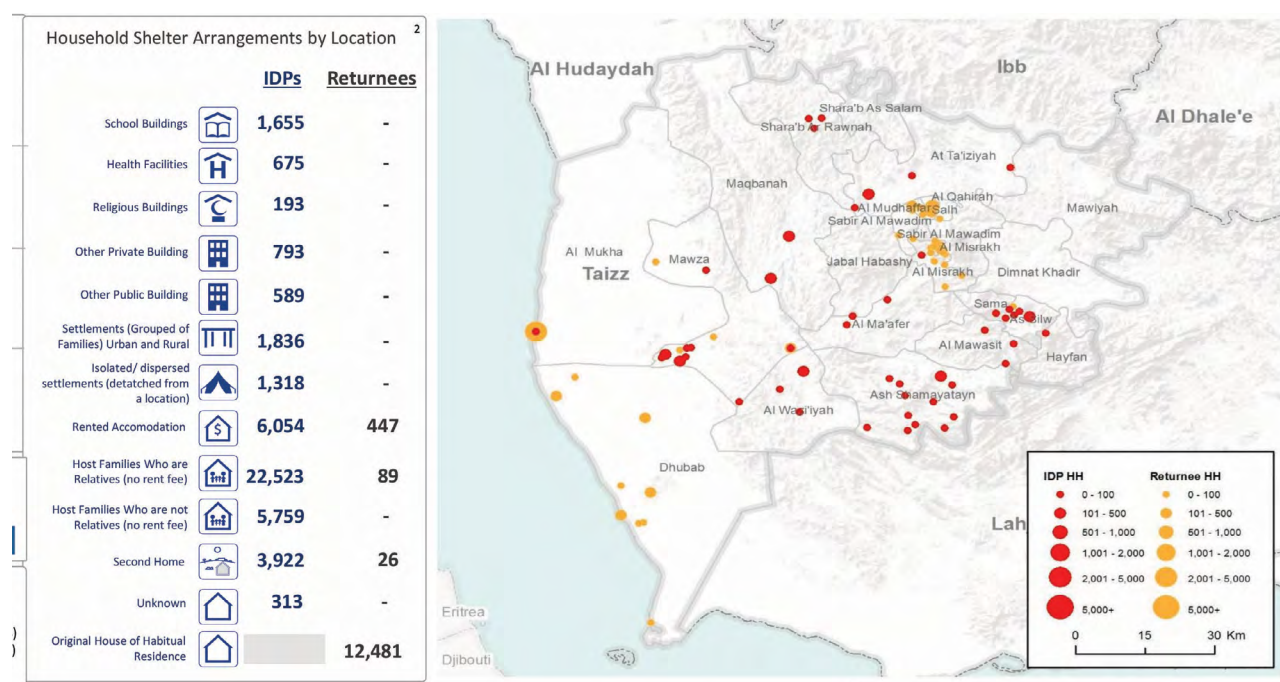
lower (people experience fewer infective mosquito bites per year). The higher risk coastal areas (where people would experience more infective mosquito bites per year) are sparsely populated. Whilst the period of malaria transmission, and thus need for protection, may be over a longer period (winter and early summer) in the moderate risk areas, the overall disease incidence over the course of the year will be much lower than that amongst populations in Hajjah, Al Hudaydah and Sa'ada. The majority of the IDPs live in rented accommodation or with host families in the more moderate malaria transmission risk population centres. There are, however, more than 3,000 IDPs who live in settlements of some sort, and at higher risk than others, and are a higher priority for malaria control interventions.

It should be noted, however, that there is a site of 6,000+ returnees and a number of refugees on the

coast in Al Mukha district, several thousand IDPs in western Mawza district, and similar numbers of returnees in Dhubab district. These are all at relatively greater risk from malaria, and in need of protection. Returnees, in this area, whilst originally exposed to more malaria, and therefore would have grown up developing partial immunity to severe

infection, should be assumed to be at greater risk than normal. If they were displaced into areas of lower transmission, for a year or more, they may have lost much of the protective partial immunity established from previously living long-term in areas of high transmission.

Figure 33: Map and Shelter information taken from TFPM report to show IDP/returnee population distributions in Taizz (Annex 7)



IDP ACCOMMODATION FOR 4 GOVERNORATES WITH HIGH DISEASE BURDEN

The table (figure 34) below gives an idea of accommodation types for IDPs by governorate, confirming that many are living with host families

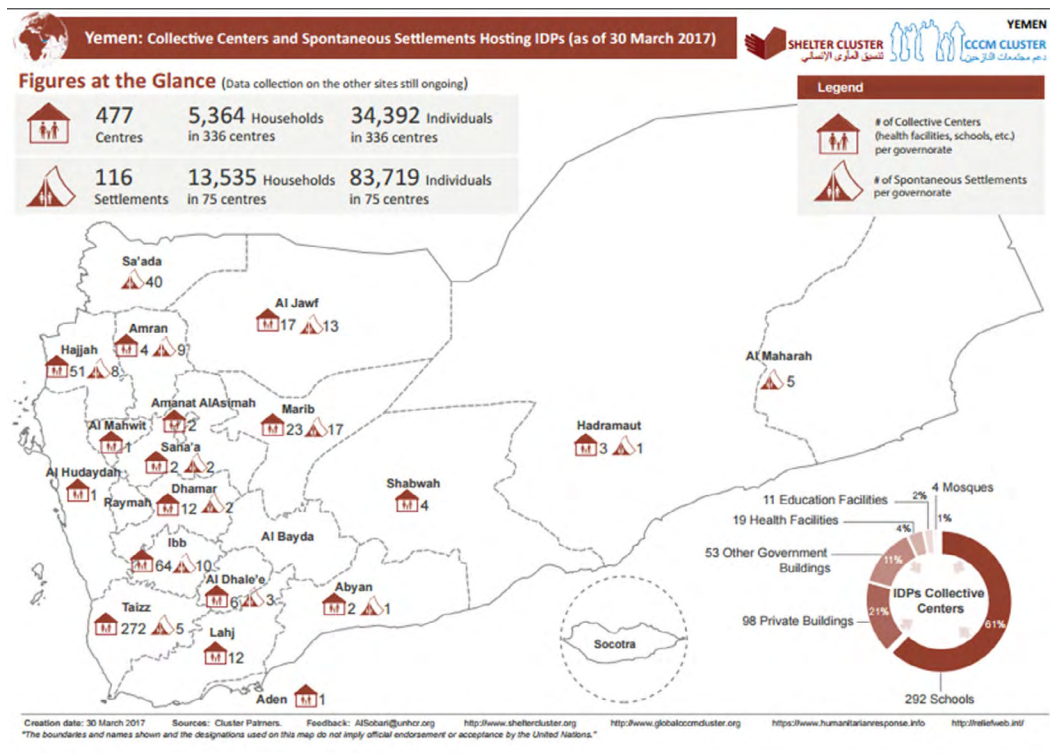
and other forms of rented accommodation, likely to be permanent structures. In Hajjah and Al Hudaydah, however, many are living in settlements, either collective or isolated, where accommodation may be more improvised. The table translates roughly to the information depicted on the map (figure 35)²⁸ below to show locations of IDP settlements, as of March 2017.

Figure 34: Shelter information taken from TFPM report to show IDP/returnee population accommodation in priority governorates (Annex 6)

Governorates	Total IDPs households	In Host Families Who are Relatives (no rent fee)	In Host Families Who are not Relatives (no rent fee)	In Rented Accommodation	In Second Home	In Settlements (Grouped of Families) Urban and Rural	In Isolated settlements (detached from a location)	Other	
Hajjah	67,654	26%	17%	4%	2%	28%	20%	2%	100%
Taizz	45,171	47%	11%	14%	10%	4%	3%	12%	100%
Al Hudaydah	17,498	21%	17%	14%	3%	22%	22%	1%	100%
Sa'ada	17,262	32%	20%	40%	1%	3%	3%	1%	100%

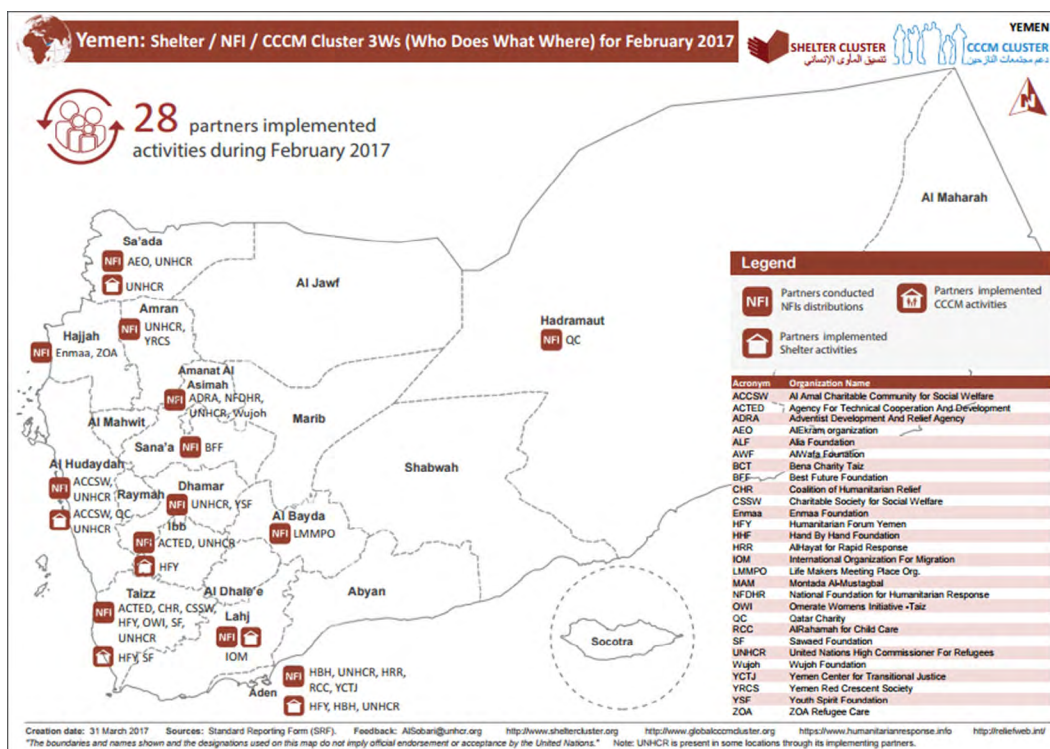
²⁸ http://reliefweb.int/sites/reliefweb.int/files/resources/shelter_nfi_cccm_cluster_collective_centers_and_settlements_march_2017_30032017.pdf

Figure 35: Map of shelter locations taken from Shelter Cluster to show Collective Centres and Spontaneous settlements with corresponding population of each



IDP RELATED NGOS PRESENT^{29,30}:

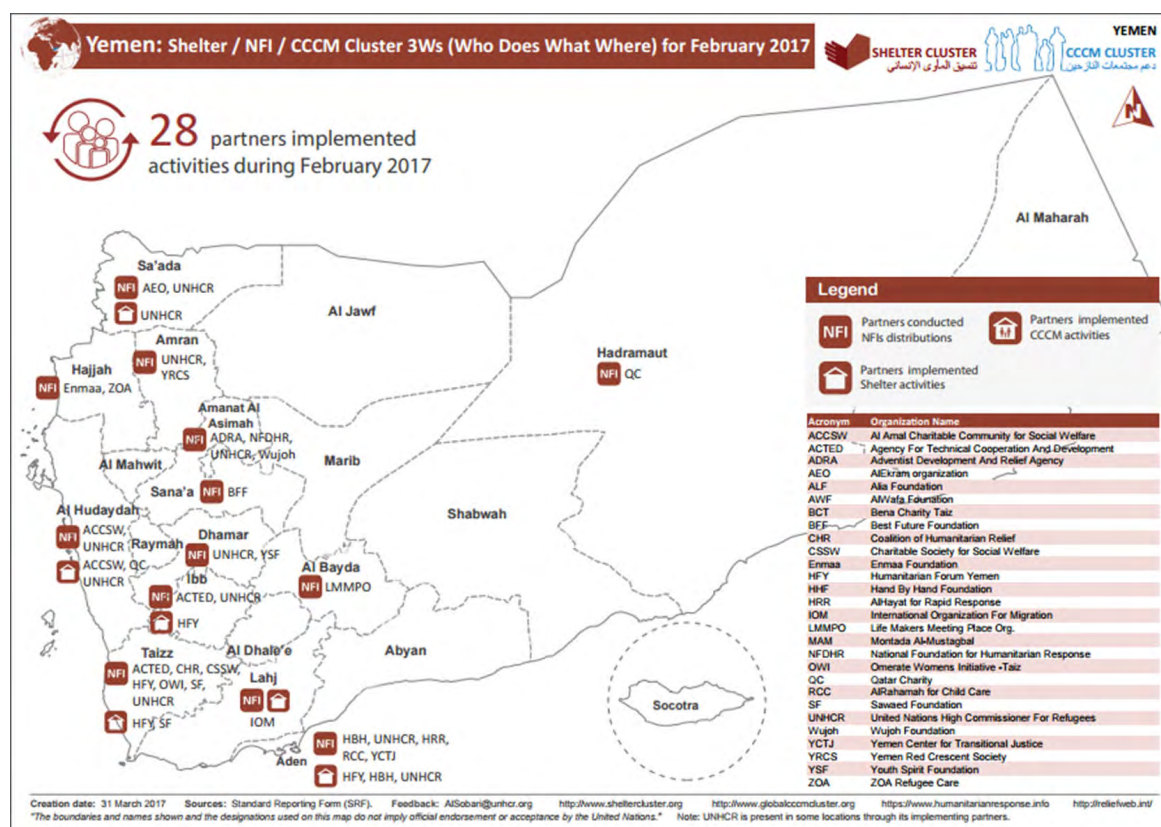
Figure 36: Map showing location of IDP related NGOs from February 2017



²⁹ www.humanitarianresponse.info/system/files/documents/files/shelter_nfi_cccm_cluster_3ws_-_february_2017-_16022017.pdf

³⁰ www.humanitarianresponse.info/system/files/documents/files/shelter_nfi_cccm_cluster-planned_distributions_for_april_2017-_05042017.pdf

Figure 37: Map showing IDP related activities planned going forward from April 2017



INTERACTIONS OF MALARIA RISK FACTORS IN OTHER POTENTIAL TRANSMISSION HOTSPOTS

THE TEHAMA REGION

AL MAHWEET

District	HF Reporting
At Tawilah	1/4
Shibam Kawkaban	1/5
Ar Rujum	3/10
Hufash	2/6
Milhan	4/7
Al Mahwait City	6/7
Al Mahwait	6/7
Al Khabt	2/8
Bani Sa'd	4/6

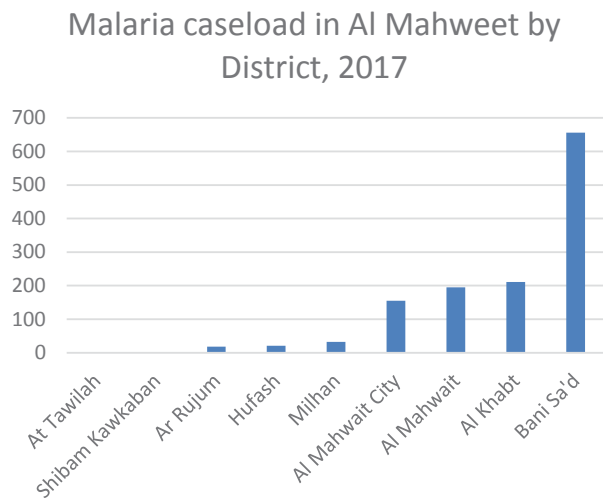
Al Mahweet is a small governorate that shares a border with Hajjah to the north and Al Hudaydah to the west. These two governorates are known to have the highest rates of disease of the whole country, it is therefore likely that a governorate of such proximity should not be overlooked in control efforts. The governorate has reported 1,292

confirmed cases of *P. falciparum* yet the breakdown by district reveals that more than double of these were reported from Bani Sa'd.

Bani Sa'd sits just in from the border of Al Hudaydah. Al Mahweet is described to have a highly variable topography, with wadis that sit at low altitude as well as areas of higher ground. Given this district is showing such a high proportion of disease, areas of low altitude, at risk of higher transmission, may well be contributing. Health facility reporting in this governorate is moderately good when compared to others and two thirds are still reporting in Bani Sa'd. It is not surprising though that those districts with the poorest rates of health facilities reporting show the lowest prevalence of disease, demonstrating the need for greater surveillance.

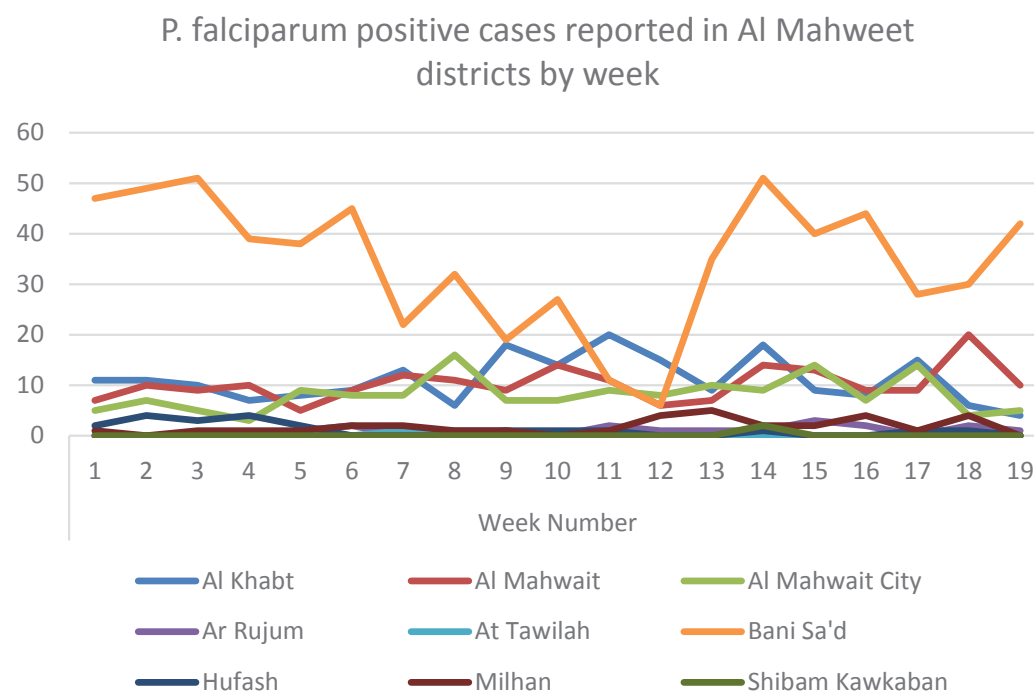
It is hard to see any seasonal trend in the cases reported by district and by week for the first 19 weeks of 2017. From the location of the governorate it is likely to predominately be in strata two, of moderate transmission. The notable decrease from week 6 and increase again at week 12 in Bani Sa'd fails to correspond adequately to any of the strata identified transmission seasons, leaving it somewhat inconclusive.

Figure 38: Health Facilities reporting per district, weeks 1-19 (2017)



The governorate has a population of 0.67 million and is estimated to have around 44,000 IDPs, well dispersed across the governorate with no obvious pockets, though 25% IDP households are reported to be in Bani Sa'd. The majority of these are being hosted by local residents, either family or not, rather than spontaneous or grouped settlements. The communities and IDPs are likely to have stretched or insufficient coping mechanisms and housing situations that may lead to increased susceptibility to disease transmission. This further highlights Bani Sa'd as a district of concern within Al Mahweet.

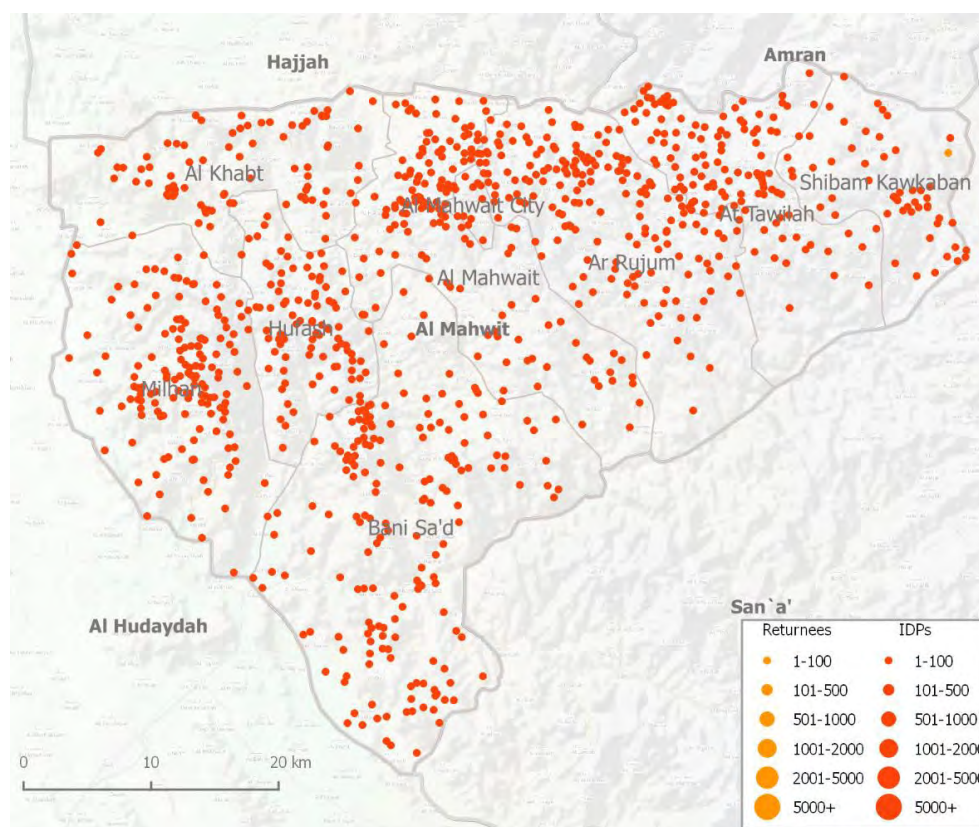
Figure 39: Cases reported by district each week (2017)



In terms of food security, Al Mahweet is classified as being in 'Crisis' and, whilst it has the highest percentage reach of SAM treatment for children of the Tehama governorates (35%), there is currently 0% reach for MAM treatment. This becomes

important should feeding programmes be an avenue considered for case management or distributions in this region. Furthermore, these MAM cases are highly susceptible to contracting malaria and developing complex or severe forms of the disease.

Figure 40: IDP data for Al Mahweet (Annex 7)



AMRAN

This governorate is just to the north of Al Mahweet and borders Hajjah to the west and Sa'ada to the north. Again this locates it between two of the governorates known to have significant prevalence of the disease. It is further inland than Hajjah so is likely to be in strata 2 and moving into strata 3 of malaria transmission risk, given the associated topography. However, like Al Mahweet, pockets of higher transmission are known to occur in wadis between the higher ground.

Confirmed caseload of *P. falciparum* is not particularly high, 1,292 for the first 19 weeks of 2017 compared to nearly 2,500 last year. However, one quarter of these were located in just one district, Al Qaflah. It should be noted that this district also recorded all 4/4 of the health facilities located within it to be reporting data.

Table 17: Health Facilities reporting per district weeks 1-19 (2017)

District	HF Reporting
Al Madan	0/4
As Sudah	0/6
Dhi Bin	0/1
Kharif	0/4
Suwayr	0/1
As Sawd	1/5
Huth	1/2
Iyal Surayh	1/4
Thula	1/5
Harf Sufyan	1/1
Shaharah	1/3
Bani Suraim	2/4
Raydah	4/4
Al Ashah	1/2
Maswar	4/4
Amran	4/7
Khammer	4/4
Habur Zulaymah	5/5
Jabal Iyal Yazid	3/6
Al Qaflah	4/4

Figure 41: Health Facilities reporting per district, weeks 1-19 (2017)

P. falciparum positive cases reported in Amran by District

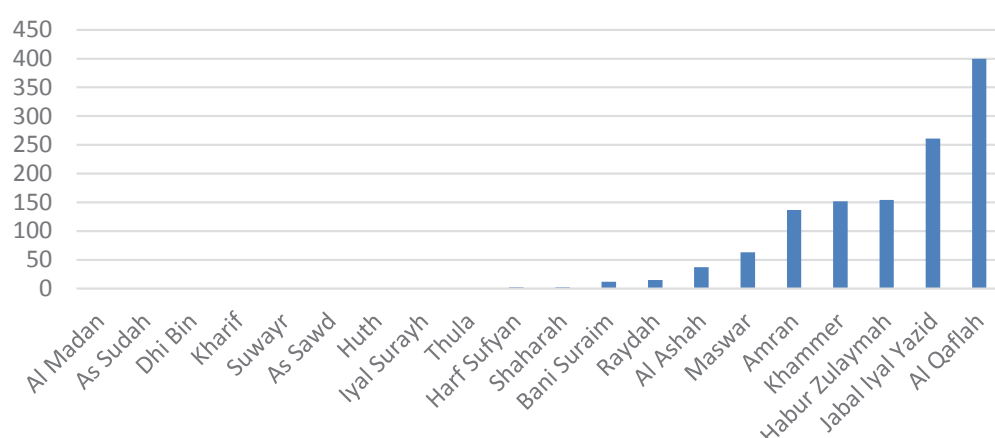
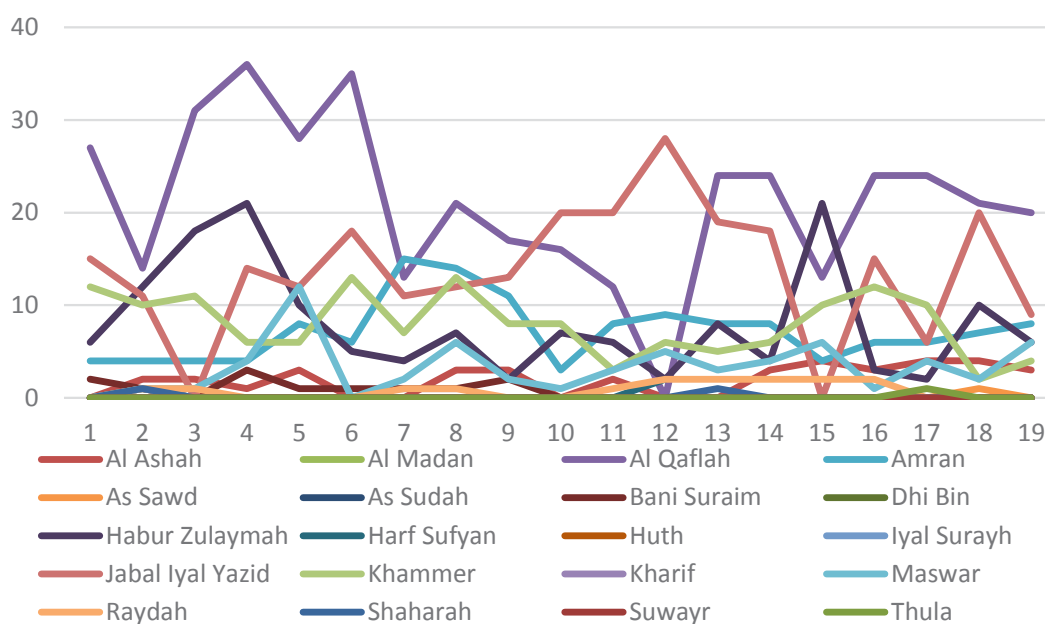


Figure 42: Cases reported by district each week (2017)

P. falciparum positive cases reported in Amran districts by week, 2017



The reporting frequency by district looks fairly erratic, again with no evident seasonal trends. The rise from week 12 onwards in Al Qaflah could be seen as transmission picks up for strata two/three towards May. However, these rates still look lower than those of weeks 3 to 6, thought to be out of season. It should be noted that the bulk of transmission is still expected to come yet already

roughly half last year's case total has been recorded. The nearly 150,000 IDPs are dispersed throughout the districts, swelling the population of 1.04 million significantly. The only concentrations of note are the 16% around the capital of the governorate, Amran. Food security is also classified as in 'Crisis' and should remain a concern with SAM and MAM percentage reach at 26% and 9% respectively.

Returnees

- 1-100
- 101-500
- 501-1000
- 1001-2000
- 2001-5000
- 5000+

IDPs

- 1-100
- 101-500
- 501-1000
- 1001-2000
- 2001-5000
- 5000+

Dhamar has a population of 1.86 million, now housing more than 140,000 IDPs. Located just to the east of Al Hudaydah and Taizz, where conflict is particularly active, it is unsurprising that many of these IDPs are located in the two districts closest to the governorate border; Wusab As Safil and Wusab al Ali house 25% and 21% respectively. The majority of these are reported to be staying with families but consideration of stretched means and coping mechanisms of both IDPs and hosts must be addressed. Food security has been assessed to be at 'Crisis' level and SAM and MAM treatments' percentage reach is 21% and 0% respectively.

District	HF Reporting
Anss	0/11
Maghirib Ans	0/10
Mayfa'at Anss	0/11
Al Manar	1/10
Al Hada	1/11
Jahran	2/14
Wusab Al Ali	5/11
Utмах	4/12
Dawran Aness	1/13
Dhamar City	13/28
Wusab As Safil	7/10
Jabal Ash sharg	11/11

District	HF Reporting
Anss	0/11
Maghirib Ans	0/10
Mayfa'at Anss	0/11
Al Manar	1/10
Al Hada	1/11
Jahran	2/14
Wusab Al Ali	5/11
Utмах	4/12
Dawran Aness	1/13
Dhamar City	13/28
Wusab As Safil	7/10
Jabal Ash sharg	11/11

Figure 44: Health Facilities reporting per district, weeks 1-19 (2017)

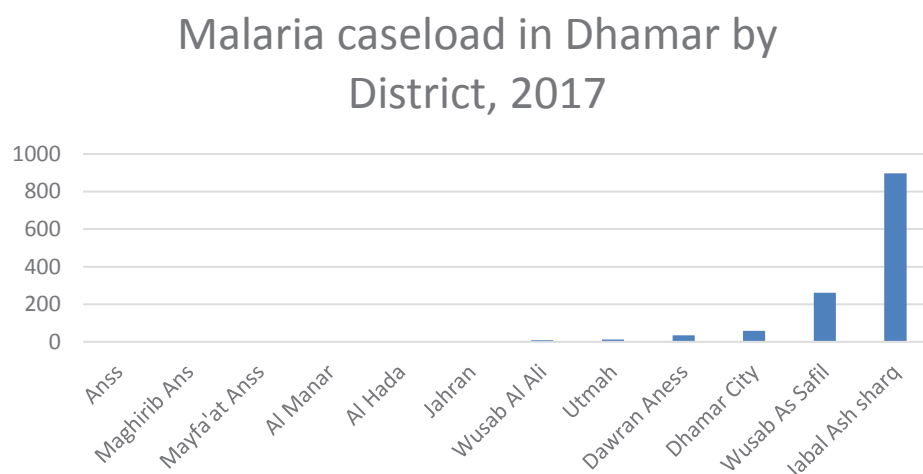
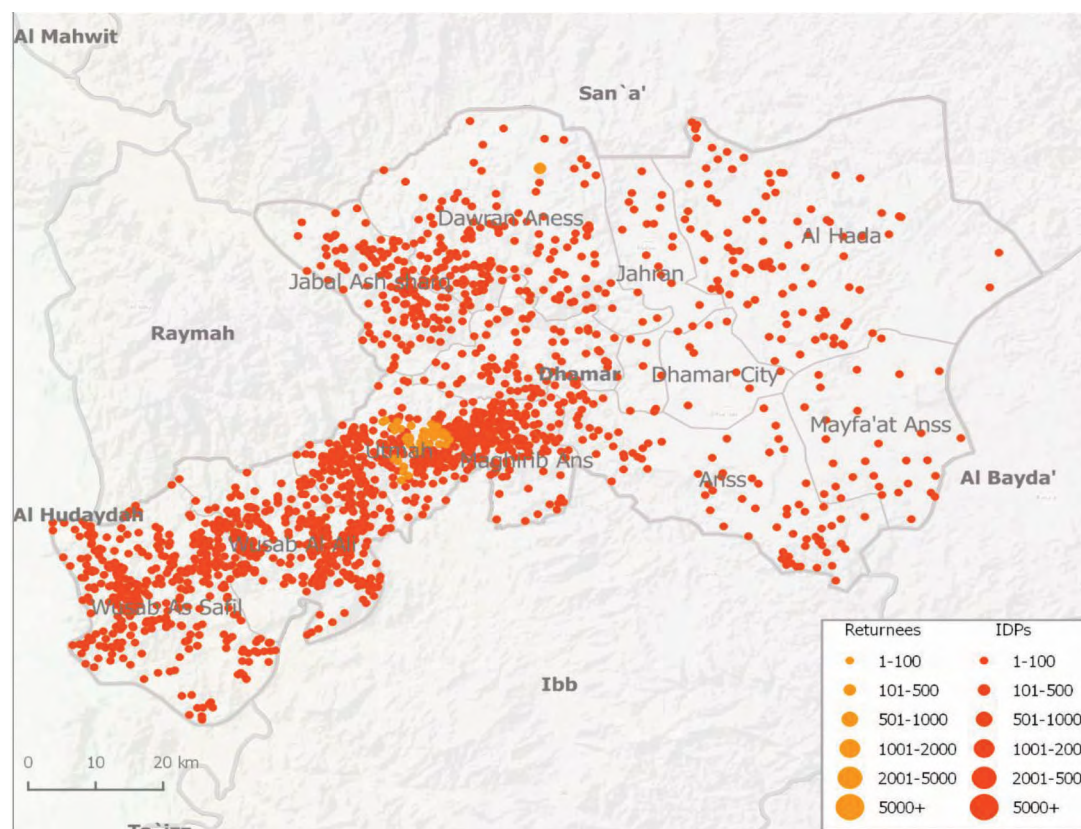


Figure 45: IDP data for Dhamar (Annex 7)



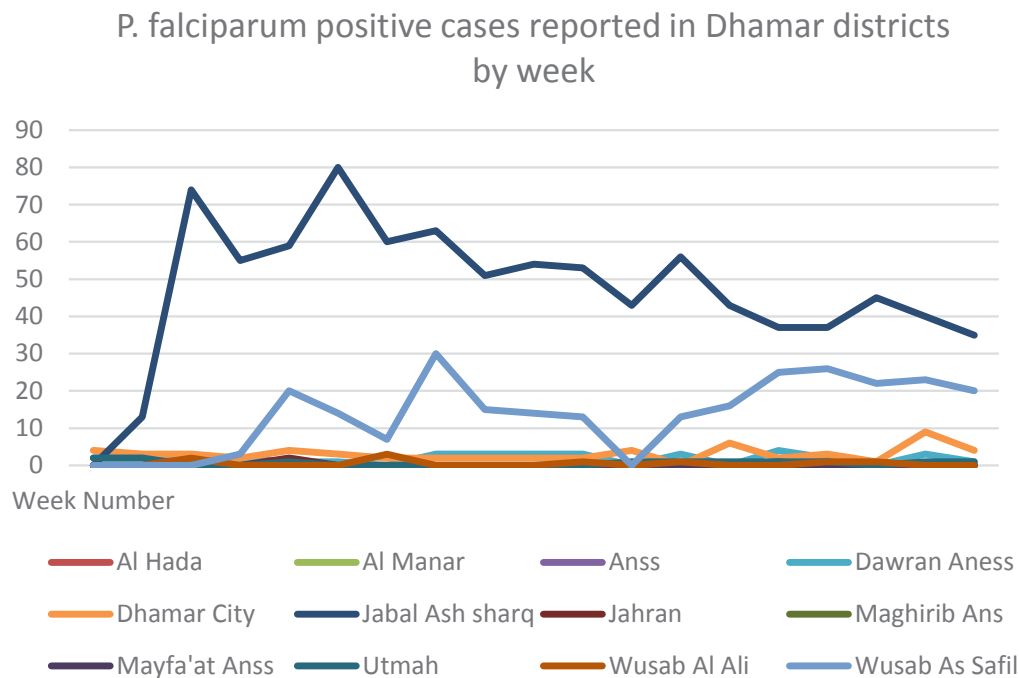
One of these districts, Wusab As Safil is also seen to have the second highest malaria burden in the governorate. However, at roughly 300 cases in the first 19 weeks of 2017, this is about a third of what has been reported in Jabal Ash Sharaq, the district with the majority of confirmed malaria cases for this time period.

As this district has 11/11 health facilities located within it reporting regularly, it is relatively well equipped for case reporting and management. It certainly has more capacity to do so than many of the other districts with much lower reporting frequencies. Seasonal trends from this district again are unclear with rises and falls either being hard to

distinguish or at points of the year not expected from strata specified transmission peaks but the bulk of transmission is still expected to come after this reporting period. This could indicate a significant

increase from last year given that cases are already roughly half last year's total before transmission peak has begun. (Malaria data from Annex 3. SAM/MAM data from Annex 4.)

Figure 46: Cases reported by district each week (2017)



IBB

Ibb sits to the east of Taizz and again 22% of IDPs in the governorate can be found Dhi As Sufal, one of the districts along the governorate border. The population of 2.78 million has absorbed over 130,000 IDPs. Food security sits at 'Crisis' level and SAM and MAM percentage reach for children needing treatment at 14% and 0% currently. Without additional support, the situation looks likely to deteriorate.

Ibb, similar to other Tehama governorates that sit further inland, is noted to have pockets of outbreaks in wadis between the high ground and, with the movement of people coming from higher transmission zones these could be of concern. So far in 2017 just 459 malaria cases have been confirmed but the expected transmission season for this governorate has yet to start. Similar to Dhamar, this could be indicative of a much higher total annual caseload given that numbers are already at about 50% of last year's total before peak transmission has begun. More than half of these cases have been recorded in Al Udayn, close to the border of Raymah and Al Hudaydah.

Reporting frequency appears to be low across the district, including Al Udayn with only 6/13 HFs recording any cases. Reporting across the weeks is low but shows signs of increasing towards the end of the reporting period, perhaps indicating increases in line with seasonal transmission peaks expected in strata 2 and 3.

RAYMAH

Raymah has a small population of 0.55 with roughly 50,000 IDPs. This governorate sits just inland to the east of Al Hudaydah. The malaria caseload so far for this year is low, at just 500, but as transmission is expected to pick up from May to September, numbers may equate to that of last year, 1500. Roughly half of these cases were recorded in Bilad At Ta'am, the northernmost governorate, sharing a long border with Al Hudaydah. The number of health facilities, total and proportional, reporting in this district is much higher than any other districts, which may be a significant factor in this.

Table 19: Health Facilities reporting per district. weeks 1-19 (2017)

District	HF Reporting
An Nadirah	0/7
Ar Radmah	0/4
As Sabrah	0/3
As Saddah	0/9
As Sayyani	0/8
Ash Shair	0/6
Badan	0/7
Ibb	0/4
Mudhaykhirah	0/6
Hubaysh	1/3
Al Makhadir	2/9
Jiblah	2/9
Yarim	3/9
Far Al Udayn	6/6
Al Qafr	3/5
Dhi As Sufal	6/10
Al Mashannah	4/12
Hazm Al Udayn	2/5
Al Dhihar	8/18
Al Udayn	6/13

Figure 47: Health Facilities reporting per district, weeks 1-19 (2017)

P. falciparum positive cases reported in Ibb by District

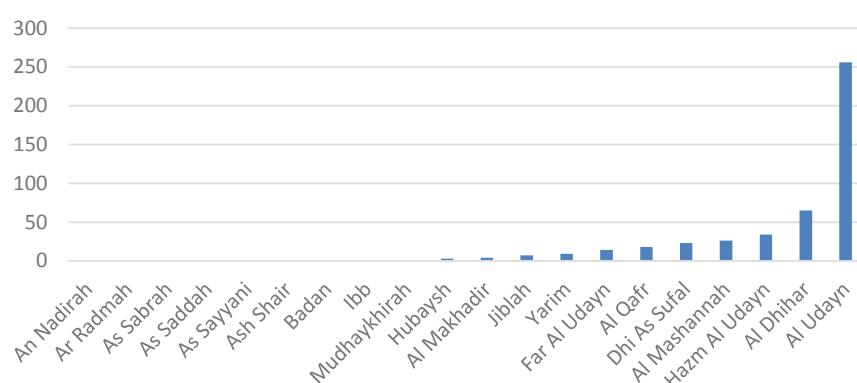


Figure 48: IDP data for Ibb (Annex 7)

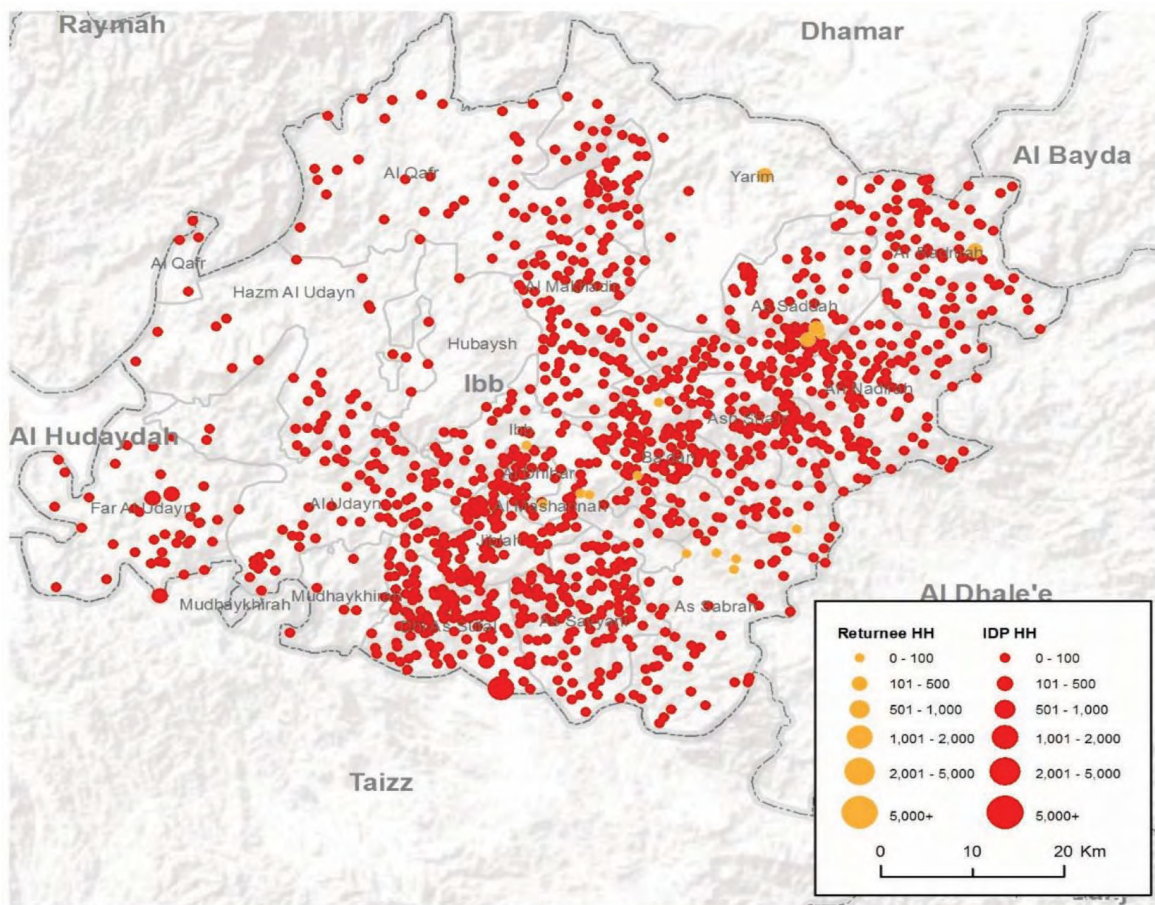


Figure 49: Cases reported by district each week (2017)

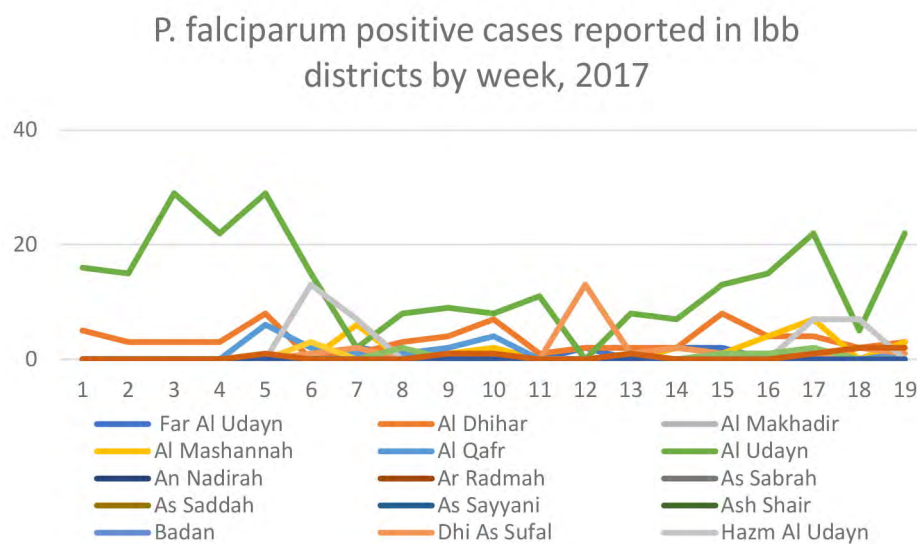


Figure 50: IDP data for Raymah (Annex 7)

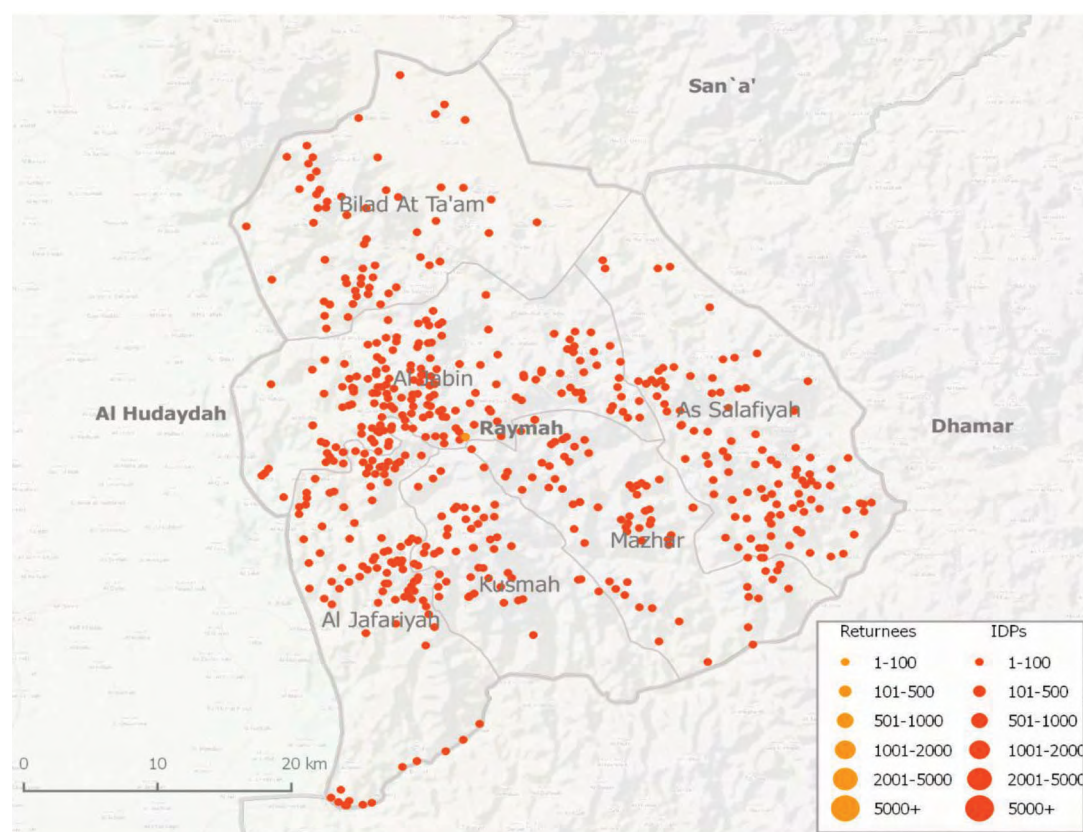


Table 20: Health Facilities reporting per district, weeks 1-19 (2017)

District	HF Reporting
Kusmah	1/11
As Salafiyah	3/10
Al Jafariyah	3/9
Mazhar	3/14
Al Jabin	6/14
Bilad At Ta'am	10/13

There do not seem to be any obvious seasonal trends emerging from the data of cases recorded by week, by district. Food security is at 'Crisis' level with SAM treatment percentage reach at 31% but 0% MAM treatment. This should be noted for possible implementation plans involving TSFPs/OTPs. (Malaria data from Annex 3. SAM/MAM data from Annex 4.)

Figure 51: Cases reported by district each week (2017)

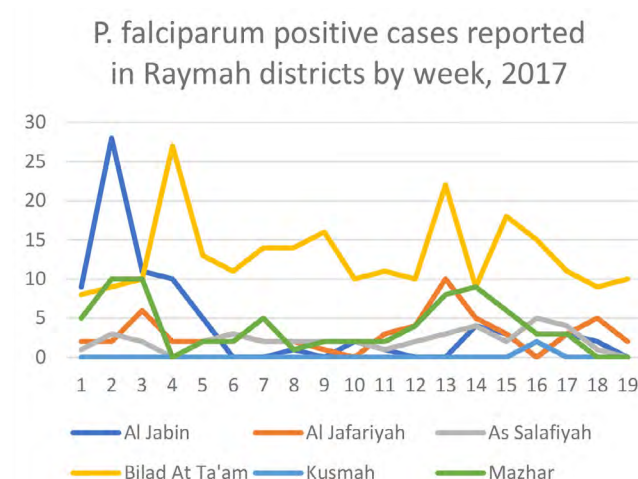
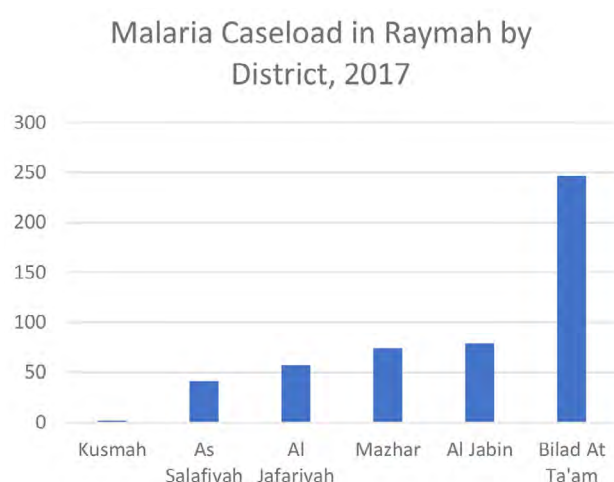


Figure 52: Health Facilities reporting per district, weeks 1-19 (2017)



SOUTHERN GOVERNORATES

Similarly to the governorates selected on the basis of high malaria burden, risk factors can be seen to varying extent across the southern governorates. Levels of displacement vary across governments but are significant in Aden and Lahj, the governorates of closest proximity to the conflict. Food security is at 'emergency' levels in Lahj, Aden, Abyan and Shabwah and 'stressed' in Al Mahra. OTP and TSFP coverage correspondingly, is better in the first four than Al Mahra, which may be of importance in recommended response strategies. The table below demonstrates the numbers beneficiaries and associated reach of SAM/MAM programmes in the five governorates.

Table 21: Data from nutrition cluster for SAM/MAM treatment (Annex 4)

	# of children (aged 6-59 months) treated for severe acute malnutrition (SAM)					# of children (aged 6-59 months) treated for moderate acute malnutrition (MAM)				
	Total	Boys	Girls	Total	% reach	Total	Boys	Girls	Total	% reach
Abyan	7,241	632	657	1,289	16.0%	28,647	1,203	1,260	2,463	7%
Aden	7,266	215	311	526	6.9%	34,667	643	788	1,431	4%
Lahj	9,352	1,002	1,152	2,154	0.2%	27,533	4,249	4,463	8,712	0.3%
Shabwah	12,124	659	670	1,329	10.8%	23,305	1,670	2,024	3,694	15%
Al Maharah	1,780	0	0	0	0%	4,535	0	0	0	0%

LAHJ

Lahj is situated at the southwestern corner of Yemen with an estimated population of 0.96 million people. Its topography is variable but the majority of the governorate sits at strata 1-2 in terms of malaria transmission risk, with some areas at strata 3. Malaria caseload reported here is relatively low according to data received from NMCP. The graph showing caseloads by week for each district demonstrates a level of inconsistency that should not be overlooked. This brings reporting frequency and data accuracy directly into question. Additional

information from Save the Children, who have been working in the area, indicates recent malaria outbreaks (16/05/2017). Four hundred cases were recorded in March, predominately in the districts of Tuban, Tur-Al Baha, Halmeen and Almusimir. NMCP data shows just 209 cases in these districts for the period spanning weeks 1-19, 2017. Save the Children have reported a further 41 cases in the districts of Tur Albaha and 66 in Al-Madarbah Wa Ras Arah, both in Lahj.

Figure 53: Cases reported by district each week (2017)

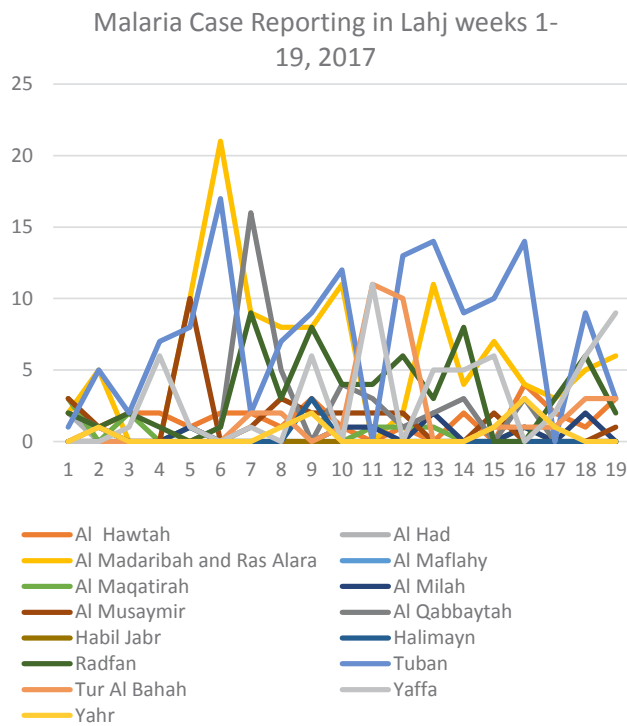


Figure 54: Health Facilities reporting per district, weeks 1-19 (2017)

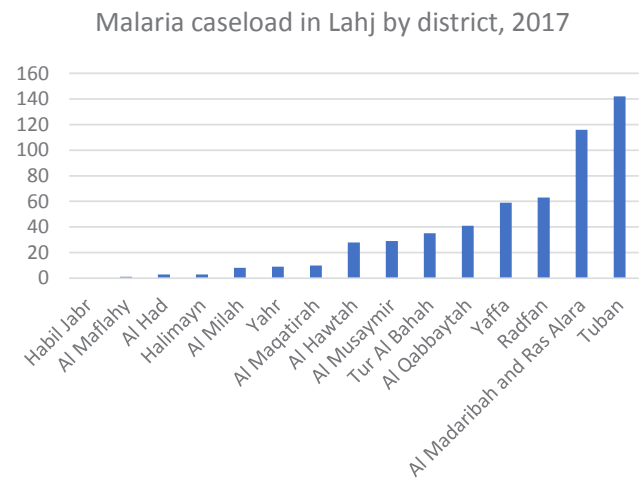
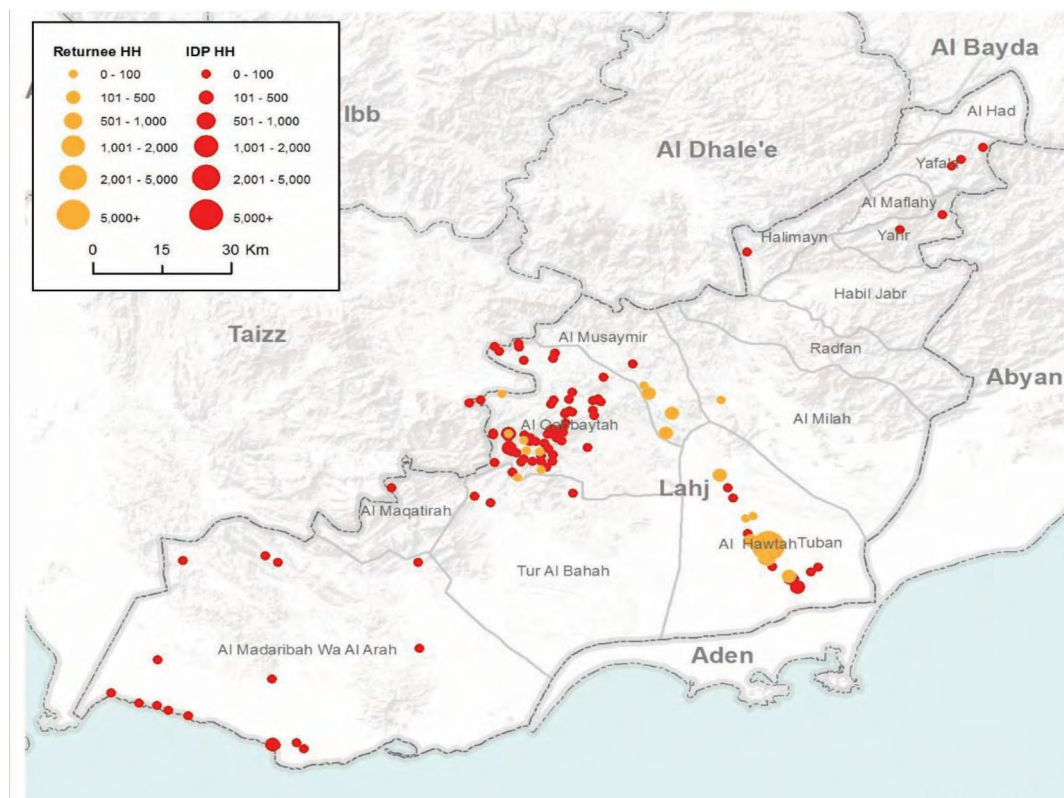


Figure 55: IDP data for Lahj (Annex 7)



Numbers remain sufficiently low for this governorate not to be considered as a priority region for malaria intervention. However, conflicting reports of outbreaks alongside its geographical suitability for malaria vectors indicate a need for improved surveillance systems in this governorate. IDP numbers (fewer than 60,000) are concentrated in districts (Al Qabbaytah) bordering Taizz, a governorate of greater burden of disease. These locations and both host and IDP communities here may be of importance in targeting surveillance and interventions to monitor disease transmission. Al Qabbaytah itself has fewer than half of its HFs reporting malaria cases which could be significant. Likewise, in districts where Save the Children has reported increased numbers, HF reporting is at similarly poor rates. An estimated 42% of the population is currently being reached by the Health Cluster. 8 districts in Lahj have been included in NMCP's LLIN distributions (October 2016), covering an estimated 365,456 individuals.

Table 22: Health Facilities reporting per district. weeks 1-19 (2017)

LAHJ District	HF reporting cases
Habil Jabr	0/8
Al Maflahy	1/6
Al Had	1/7
Halimayn	1/6
Al Milah	3/7
Yahr	2/6
Al Maqatirah	3/7
Al Hawtah	3/6
Al Musaymir	3/6
Tur Al Bahah	2/4
Al Qabbaytah	4/9
Yaffa	7/11
Radfan	9/14
Al Madaribah and Ras Alara	6/9
Tuban	8/17

Save the Children are providing support to health services in parts of Lahj where they are operating. They include malaria diagnostic and treatment services as part of a wider response for primary health. They report an increase in IDP numbers coming into Lahj from 'hot point villages', often originating from neighbouring Taizz where they are fleeing conflict. Save also reported that health facilities in Lahj were commonly experiencing severe stock outs of some essential medicines.

MoPHP have confirmed that their Lahj office is able to function and is continuing to supply the HFs with malaria RDTs and drugs, as per the national policy (table 17).

It should also be noted that, whilst OTP and TSFPs appear to be quite widespread in districts across Lahj (figures 32 and 33), the % reach of treatment of children suffering from SAM/MAM is especially low (0.2%/0.3% respectively). Again this may be significant in considering interventions for this area as potential for presenting complex cases of malaria may be high.

Table 23: National malaria case management protocol taken from WMR, 2015⁵⁵

Antimalaria treatment policy	Medicine	Adopted
First-line treatment of unconfirmed malaria	AS+SP	2009
First-line treatment of <i>P. falciparum</i>	AS+SP	2009
Treatment failure of <i>P. falciparum</i>	AL	2009
Treatment of severe malaria	AM; QN	2009
Treatment of <i>P. vivax</i>	CQ+PQ(14d)	-
Dosage of primaquine for radical treatment of <i>P. vivax</i>		0.25 mg/kg (14 d)
Type of RDT used		P / only

ADEN

ADEN District	HF reporting cases
Al Mualla	2/4
Attawahi	2/4
Sairah	6/6
Al Buraiqeh	6/11
Dar Sad	4/5
Khur Maksar	2/6
Ash Shaikh Outhman	8/8
Al Mansura	12/18

Aden is a small governorate situated along the southern coast with a population of 0.89 million, of whom an estimated 33,822 are IDPs. These IDPs and a significant number of returnees tend to be concentrated in the population centre around the port and city of Aden itself, predominately in rented accommodation or with relatives.

Malaria burden in the governorate again does not appear to be particularly significant when seen on a global level. However, the graph below showing cases by district highlights Al Mansura to be reporting roughly four times more cases than the next highest district, Ash Shalkh Outhman. This could indicate a number of different scenarios. Al Mansura could simply be a site where an isolated epidemic has broken out and should be targeted as such for interventions. Aden is a small governorate

and its topographical variability is not likely to be huge, given that the thin strip of coastal land it occupies is unlikely to be much beyond strata 1 of malaria risk of transmission. If the data from Al Mansura is accurate it may, therefore, confirm underreporting in the other districts, bringing the caseload of the governorate as a whole up to a much more concerning level of disease. It should be noted that Al Mansura has 18 HFs, 12 of which have reported cases. This represents both more health facilities reporting and in total, potentially accounting for a greater capacity of recording cases. What is particularly concerning is the caseload has already surpassed that of 2016, not accounting for the potential surge to come with estimated seasonality starting in October/November.

Again, it should be of note that percentage reach of SAM/MAM treatment for children is low, 6.9% and 4% respectively. The distribution of TSFPs and OTPs is slightly lower in Aden than Lahj, estimated to be between 50-74%, according to nutrition cluster data (figures 32 and 33).

Figure 56: Health Facilities reporting per district, weeks 1-19 (2017)

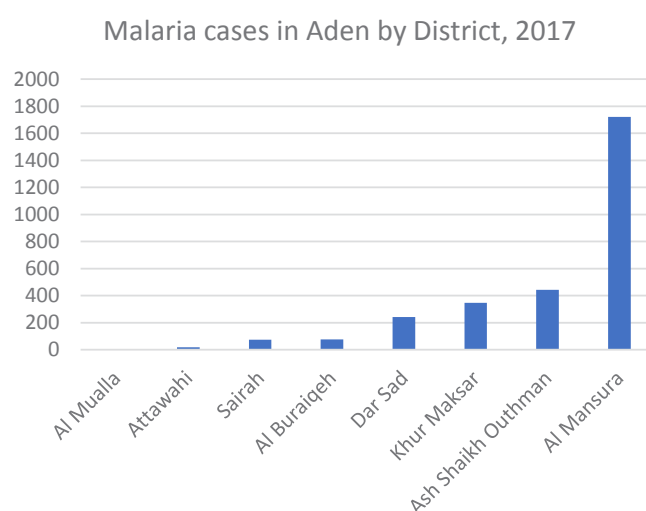


Figure 57: Cases reported by district each week (2017)

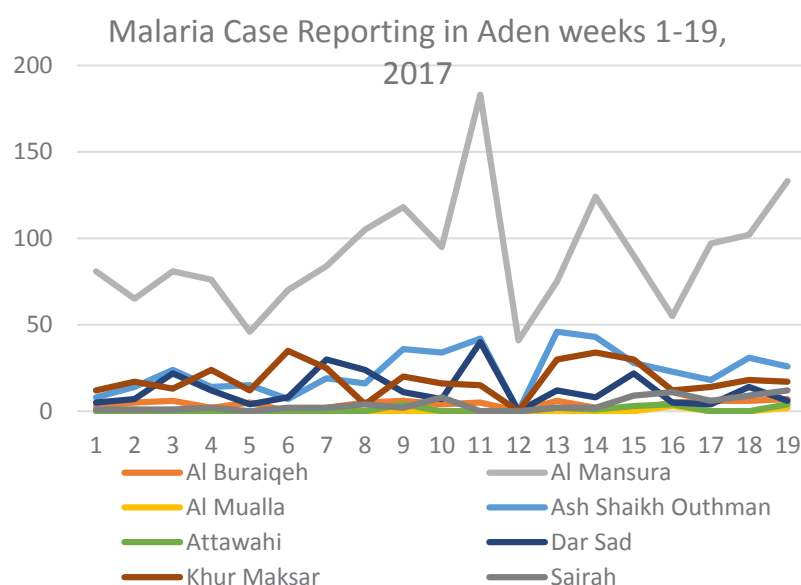


Figure 58: IDP data for Aden (Annex 7)

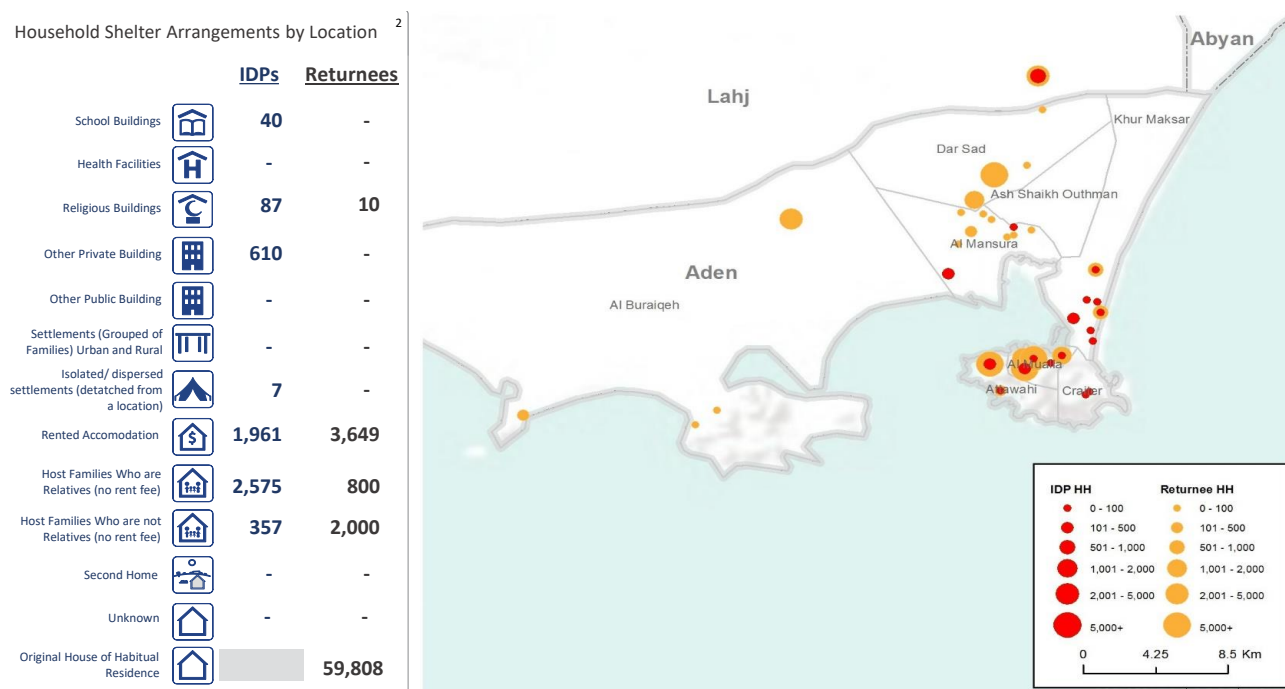


Table 25: Health Facilities reporting per district. weeks 1-19 (2017)

ABYAN

ABYAN District	HF reporting cases
Al Mahfd	0/1
Al Wade'a	0/1
Jayshan	0/2
Rosod	0/3
Sarar	0/3
Sibah	0/4
Zungobar	0/4
Ahwar	2/7
Mudiyah	4/5
Khanfir	3/26
Lawder	3/10

Bordering the corner of Aden and Lahj to the west, Abyan has a smaller population of 0.56 million including roughly 15,000 IDPs. It is also a coastal governorate, mostly in strata 1 and 2 of malaria transmission risk and some areas in strata 3. Malaria caseload recorded so far for 2017 appears to be insignificant, with just 108 cases *P. falciparum* confirmed. Even with the expected increase of cases to come at the start of the malaria season (October/ November) this appears questionable in light of the recorded caseload for 2016 being 2,457. The district reporting the highest number of cases is more inland and towards higher ground, the corresponding increase in cases over summer months can be seen on the graph below. There is little other indication of seasonal variability and reporting levels are very low, with no HFs reporting cases in over half of the districts. Abyan is also classified as at 'emergency' levels, in terms of food security. There is slightly improved percentage reach of SAM/MAM treatment of children (16%/7%) but it is still far from comprehensive.

These factors point to a significant need to improve and support surveillance and data collection in this governorate to better understand the current situation.

Figure 59: Health Facilities reporting per district, weeks 1-19 (2017)

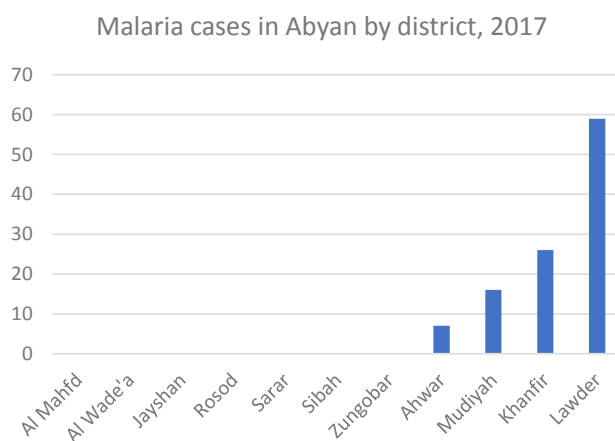


Figure 60: Cases reported by district each week (2017)

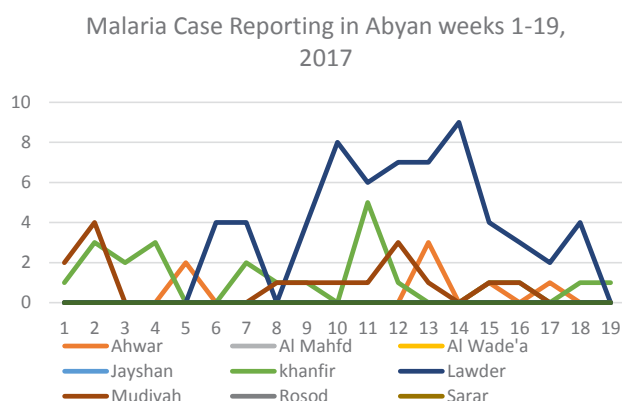


Figure 61: IDP data for Abyan (Annex 7)

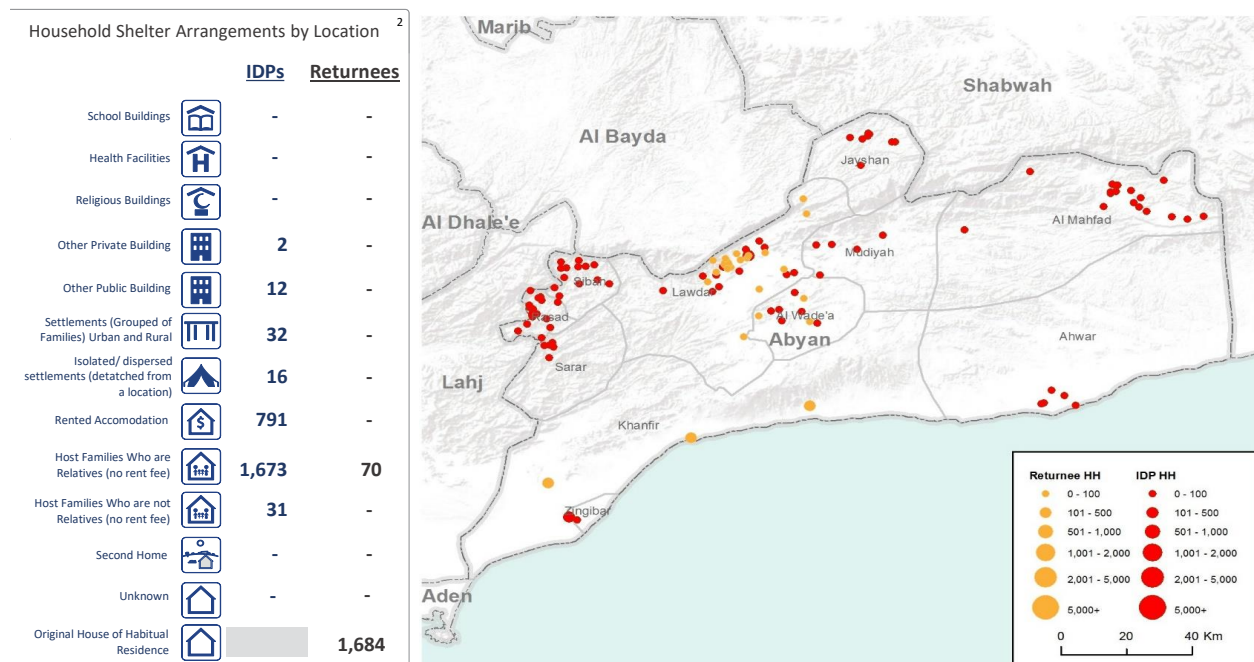


Table 26: Health Facilities reporting per district, weeks 1-19 (2017)

District	HF reporting cases
Ain	0/3
Arma	0/4
As sa'aid	0/7
At'talih	0/1
Douhr	0/2
Jirdan	0/2
Nisab	0/5
Osailan	0/3
Baihan	1/4
Ar-rawdah	1/5

Ataq	2/16
Markhah Al Alya	1/7
Habban	2/5
Mayfa'ah	5/6
Rodhoom	3/4

SHABWAH

Shabwah is a relatively large governorate with a population of just 0.62 million, including just over 14,000 IDPs. Shabwah covers a wide area geographically, including strata 1, 2 and 3 for malaria transmission risk. Save the Children reported a 900% increase in malaria transmission from 2015-2016 with a reported jump from 155 to 1,067 cases.

This still represents a somewhat modest total when compared to governorates with a heavier disease burden. The data from 2017 shows a total of the first 19 weeks recording 813 cases. This is particularly interesting given that the vast majority of these cases were recorded in the district of Rhodhoom (736%), the district that lies along the coast and thus area at highest risk of transmission. The case reporting from this district shows a sharp increase from week 10 onwards, which is in contradiction to what might be expected from seasonality of

malaria at this altitude. Furthermore, 8 out of the 15 districts did not report any malaria cases during the reporting period. Both points bring into question the validity of the data.

The food security levels in Shabwah are also at 'emergency' and percentage coverage of treatment of SAM/MAM for children is at 10.8% and 15%. This represents a serious problem, as in the above governorates. Support is required for more robust surveillance.

Figure 62: IDP data for Shabwah (Annex 7)

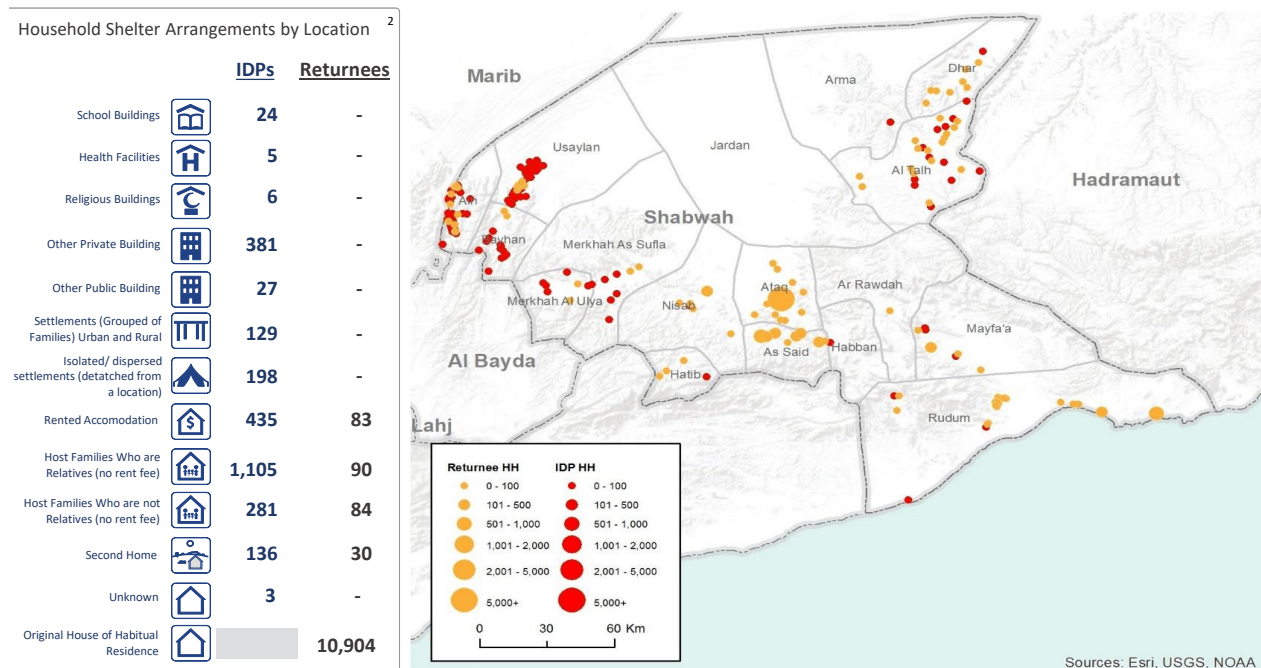


Figure 63: Cases reported by district each week (2017)

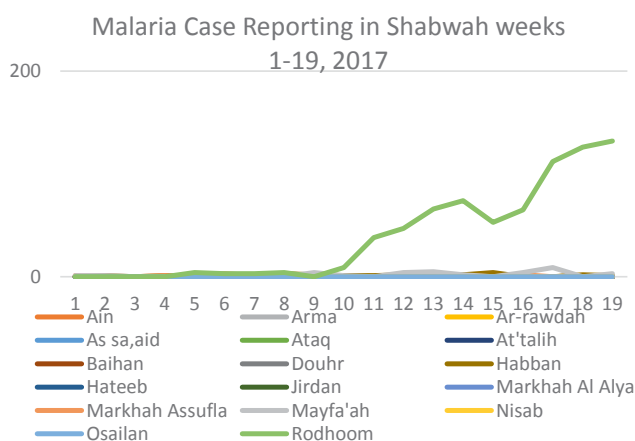
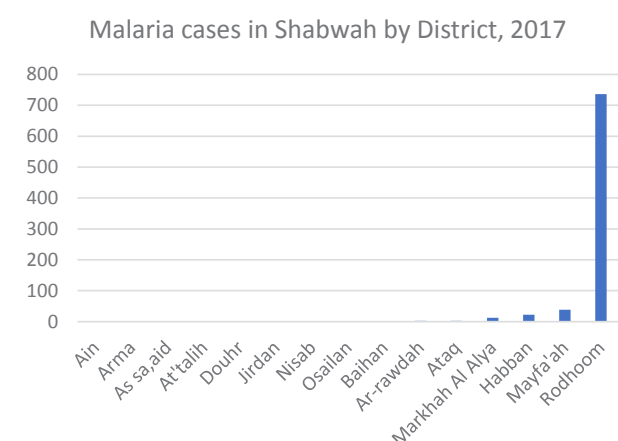


Figure 64: Health Facilities reporting per district, weeks 1-19 (2017)



AL MAHRAH

Table 27: Health Facilities reporting per district. weeks 1-19 (2017)

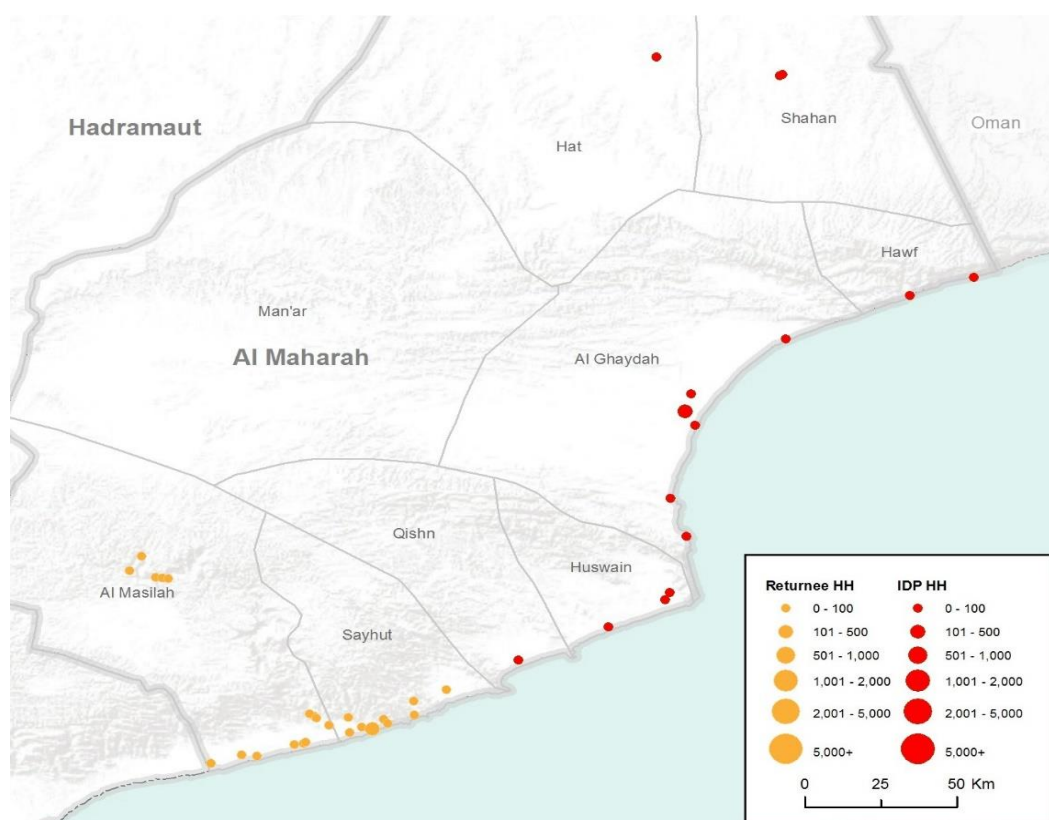
AL MAHRAH District	HF reporting cases
Hawf	0/4
Man'ar	0/1
Hat	1/1
Al Masilah	1/3
Huswain	1/3
Qishn	1/3
Sayhut	4/7
Shahan	1/2
Al Ghaydah	12/20

Similar to above Al Mahrah, Save the Children reported a 900% increase in malaria caseload from 2015-2016. The figures are still quite insignificant when compared to areas of greater concern, at 896 last year and 380 so far this year. It is the eastern-

most governorate in Yemen and much of the inland area is desert. As such it has a low population of just 0.14 million and just over 3,000 IDPs. The areas of concern, in terms of malaria, are more likely to be along the coast and indeed, this is shown in the data, with Al Ghaydah as the district of both the longest coastline and greatest burden of disease (319 cases). It is also of note that Al Ghaydah has more than double the number of HFs which may be a factor in the increased numbers recorded here. Reporting frequency appears to be low across the governorate. Once more the data that is reported does not appear to be consistent with expected seasonal variations. Whilst there is a decrease from the beginning of the year, there are two unseasonal peaks in weeks 13-14 and 18, seen in Al Ghaydah.

Malnutrition is less of a concerning risk factor in this governorate but still should be considered as food security remains at 'stressed' levels. (Malaria data from Annex 3. SAM/MAM data from Annex 4.)

Figure 64: IDP data for Al Mahra (Annex 7)



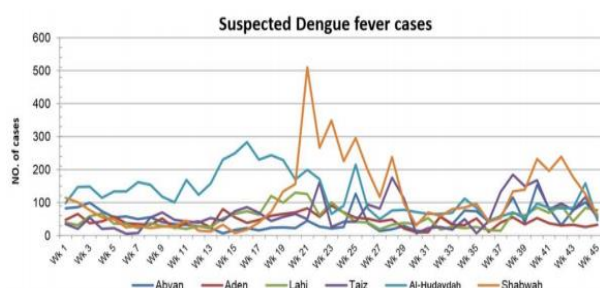
OTHER VECTOR-BORNE DISEASES OF POTENTIAL IMPORTANCE IN YEMEN

In line with the WHO's recommendations for Integrated Vector Management (IVM)³¹, this report considers the burden and epidemiology of various other neglected tropical diseases (NTDs) known to be endemic to Yemen, especially those diseases that are relevant to the four priority governorates. The report attempts to highlight opportunities for potential synergies with multi-sectoral responses, where areas of high transmission overlap.

DENGUE FEVER

Dengue fever is the most commonly transmitted arboviral infection in humans spread by the bite of *Aedes aegypti*, primarily, and to a lesser extent *Aedes albopictus*. The disease is rarely fatal but can be of varying severities, including haemorrhagic manifestations which can lead to death. Most cases present with fever, joint pain, headaches, and rashes and, as such, is commonly misdiagnosed causing widespread underreporting. There is no treatment currently available, and therefore, control measures become of critical importance. *Aedes aegypti* live predominately in urban areas, breeding in containers that collect rainwater and are exophilic, daytime biters. Risk of transmission and outbreaks are associated with poor infrastructure due to unplanned urbanisation, rainfall and warmer temperatures and roughly 60% of Yemen's population live in at risk areas.

Figure 67: reported dengue cases weeks 1-45, 2016 by governorate suspected outbreaks³³



In the current conflict setting, the risk of dengue transmission is increased exponentially, given the limitations on the healthcare system and disease control activities. Furthermore, displacement at a scale seen in Yemen results in chaotic urbanisation where dengue transmission can be rife. The effect of this has been seen on the increasing number of outbreaks recorded in the past couple of years (figure 67³²). From January to June 2016 there were 17,796 recorded cases of dengue and 41 deaths, compared to just 1,755 cases for the same timeframe in 2015³³. The WHO has been responding to this need, conducting a 5 day fogging campaign in one badly affected district in Hadramout, IRS campaigns covering 50,000 households in various governorates and training health workers in case management alongside complementary community awareness sessions³⁴. It should be noted that IRS has only limited vector control impact, given that *Aedes* bite outside or inside, during daylight hours. The recommended control activities are source reduction through mechanical or chemical control of the types of water containers preferred by *Aedes* as breeding sites. This may include old tyres, domestic water storage tanks, waste containers or even NGO water tanks for IDP camps. Control of *Aedes* vectors has the added advantage of reducing the risk of all *Aedes* borne disease threats (Dengue, Chikungunya, Yellow Fever and Zika).

Figure 68: Dengue Cases (Al Hudaydah) weeks 1-18, 2017



³¹ www.who.int/malaria/areas/vector_control/Draft-WHO-GVCR-2017-2030.pdf

³² www.emro.who.int/images/stories/yemen/WHO_Yemen_situation_report_November_2016rev.pdf

³³ www.emro.who.int/images/stories/yemen/WHO_Yemen_situation_report_Issue_30_June_2016_final.pdf?ua=1

³⁴ http://reliefweb.int/sites/reliefweb.int/files/resources/who_response_to_dengue_fever_00016-11-2015r_0.pdf

In 2015, there were just 8 Yemeni governorates noted to be dengue affected, including Hajjah, Al Hudaydah and Taizz. With warmer temperatures recorded and constant movement of people the disease profile has moved beyond these boundaries. There were 13 governorates reported suspected dengue cases during week 45, 2016 (November)³³ alone and a recent ACAPS report confirmed that dengue fever is present now in 13 governorates, spreading particularly fast in Taizz³⁵.

Table 28: Dengue cases recorded in four priority governorates 2017, weeks 1

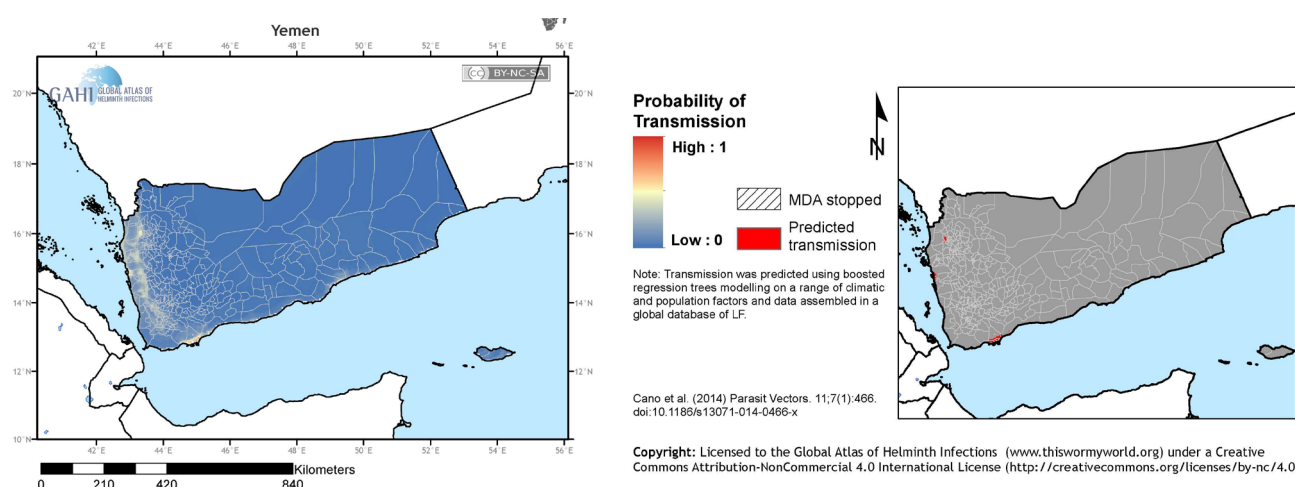
Governorate	Cases	Deaths
Al Hudaydah	4,883	0
Hajjah	54	1
Sa'ada	15	0
Taizz	22	0

In the first 18 weeks of 2017 cases were reported in all four priority governorates (table 28). As a result, more comprehensive and wider reaching preventative measures to control vectors are considered to be necessary. **Of the four governorates, Al Hudaydah is of most concern as it had 4,883 recorded dengue cases (Figure 68) in the first 18 weeks of this year.** Data recently provided by the MoPHP demonstrates this showing weeks 1-18, 2017 cases by governorate (Annex 3).

LYMPHATIC FILARIASIS (LF)

The maps below show the environmental predictors of where lymphatic filariasis can be transmitted. It is the only country in the MENA region where transmission is co-endemic for onchocerciasis³⁶. Both are filarial infections, with onchocerciasis causing blindness and LF leading to elephantiasis if left untreated. The social and economic impacts of these diseases can be devastating in addition to the associated physical disfigurement and pain. There are a number of vectors for LF, predominately mosquitoes of the genus *Culex* in urban and semi-urban areas with *Anopheles* and *Aedes* both implicated elsewhere. Yemen has a history of conducting mass drug administrations to combat the effects of this disease on its population. The combined treatment of albendazole and ivermectin can provide protection for an at-risk population as it reduces microfilariae concentration in the blood and thus transmission to mosquitoes through biting. MDAs in Yemen, 2010, had reduced prevalence of microfilariae in the blood to <1%, the threshold for discontinuing such activities³⁶. However, as seen from the maps below (figure 69³⁷) the environmental risk factors are still present and the paper describing the success of MDAs in Yemen specifically cautions: '*civil unrest may cause a break in the elimination efforts of the country*'. It should be noted that predicted areas of moderate transmission overlap with many of the higher priority areas highlighted for malaria control activities.

Figure 69: Maps showing probability of transmission according to geographical indicators for LF³⁷



³⁵ Leishmaniasis in Yemen: a clinicoepidemiological study of leishmaniasis in central Yemen

³⁶ <http://journals.plos.org/plosntds/article?id=10.1371/journal.pntd.0001475#s3>

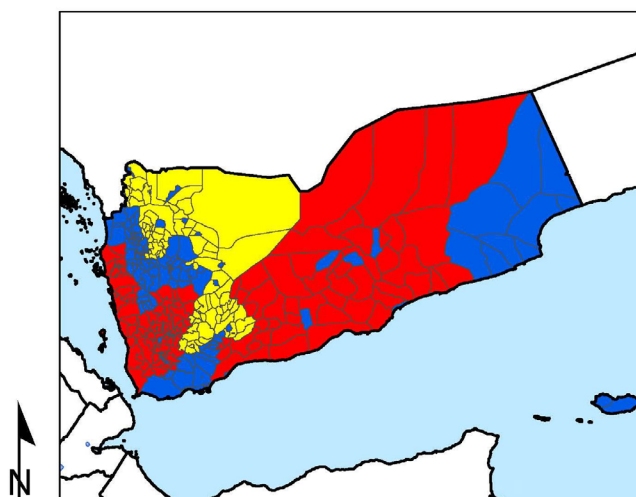
³⁷ www.thiswormyworld.org/maps/environmental-suitability-for-lymphatic-filariasis-transmission-in-yemen

Prevalence (%)

- 0%
- 0.1% - 1%
- 1% - 10%
- 10% - 50%
- > 50%

Endemicity status

- ▨ MDA stopped
- Endemic
- Non-endemic
- Unknown



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LEISHMANIASIS

Leishmaniasis is a disease caused by a single-celled protozoan parasite spread by the bite of the female phlebotomine sandfly. There are multiple species of both the sandfly and the parasite. In a similar manner to mosquitoes, female sandflies require blood meals to develop their eggs and complete their life cycle, feeding on both off human and animals. There are two main forms: (1) Cutaneous leishmaniasis (CL) which consists of large ulcerated lesions that tend to be on the exposed parts of the body such as the face and hands, where, without early diagnosis and treatment, it causes heavy scarring. This is both disfiguring and stigmatizing, especially for women and children. (2) Visceral leishmaniasis (VL) is an internal form found mainly in children less than 5 years old and is fatal if not treated. Again, it is a largely urban disease associated with poverty and overcrowding, with its transmission and severity compounded by conflict. Damage to buildings and the build-up of rubble and domestic waste provides the ideal breeding ground and resting sites for sandflies. Sandflies exhibit similar feeding behaviour to malarial mosquitoes, biting their hosts mainly at night, indoors. They differ in their flight patterns in that sandflies fly low to the ground and generally seek their host at

ground level. Malaria prevention activities, such as LLINs and IRS, consequently provide co-protection for both malaria and leishmaniasis in areas where these diseases coexist (see figure 70 for last known areas of prevalence³⁸).

Yemen lacks sufficient solid epidemiological data for leishmaniasis but cases of CL are thought to exceed 10,000 a year³⁹ and the whole country is endemic, other than highland regions above 2300 mASL⁴⁰. The strains of the parasite present are *L. major*, *L. tropic*, *L. infantum* and *L. dovani* with peak transmission rates in August. Al Bayda is noted to be the region of highest endemicity and rural populations living in unplanned slums or settlements with nearby open water sources are particularly at risk⁴⁰. It is thought that conflict and displacement is placing urban populations increasingly at risk due to resultant overcrowding, damaged buildings, poor sanitation, increased population of dogs and flies as well as open wounds being a prime target for sandfly bites. There is a noted disconnect between physician and patient knowledge as well as a severe shortage of affordable and effective treatments. The burden of social stigma falls particularly heavily on women, given societal expectations and disproportionate gendered restrictions on access to healthcare which are exacerbated by the ongoing conflict⁴¹.

³⁸ www.who.int/leishmaniasis/resources/YEMEN.pdf

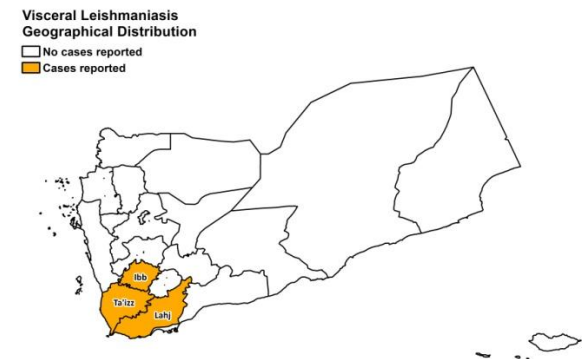
³⁹ www.ncbi.nlm.nih.gov/pubmed/26547479/

⁴⁰ www.who.int/leishmaniasis/resources/YEMEN.pdf

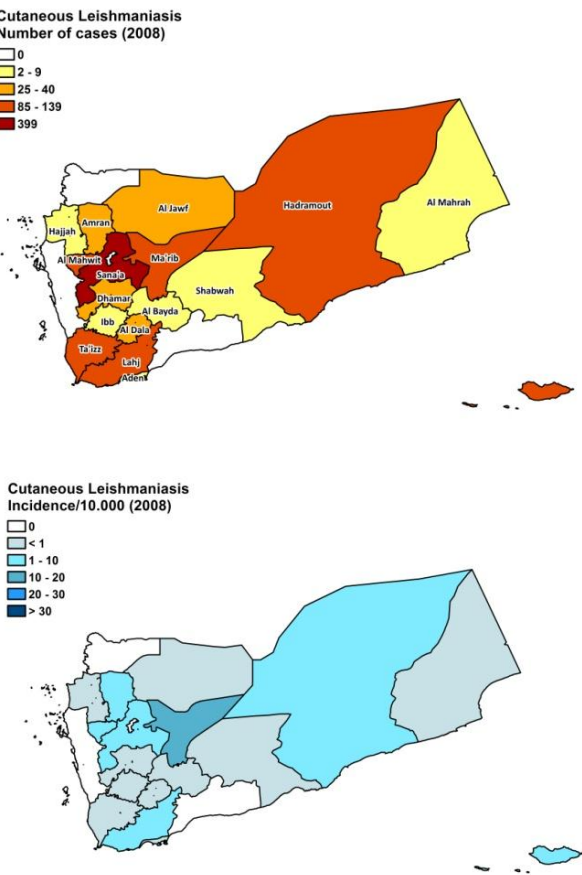
⁴¹ https://reliefweb.int/sites/reliefweb.int/files/resources/rr-yemen-gender-conflict-analysis-201016-en_0.pdf

Figure 70: Maps showing areas where cases of VL and CL have been reported (data from 2008 so is likely to have changed, particularly since the war)

Visceral leishmaniasis



Cutaneous leishmaniasis

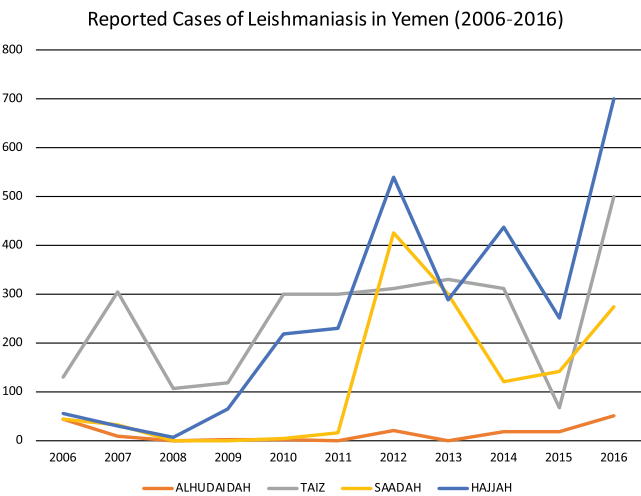


The data collected for the purposes of this report is courtesy of Dr Al-Kamel, Director of the Regional Leishmaniasis Control Centre. Raw data from clinics associated with this organization have been compiled in the above graph to demonstrate caseload in the priority governorates for malaria (figure 71).

There is little known about the presence and prevalence of VL in Yemen however, both *L. infantum* and *L. dovani* are known causative agents of VL, strongly suggesting that it may be going unreported.

It is not possible to diagnose VL on a clinical basis alone and is commonly misdiagnosed where appropriate training and equipment is missing. Neither zoonotic or anthroponotic modes of transmission can be eliminated and, given the potential fatality of the disease and history of reported cases in Ibb, Taizz and Lahj, further investigation should be considered. RDTs, similar to those used for malaria, are commercially available and in wide use across northern Syria.

Figure 71: Graph to show CL caseload in priority governorates, data provided by RLCC (Annex 8)



MALARIA CONTROL IN YEMEN TO DATE

Historically, there have been noted successes in Yemen's malaria prevention and management activities, with areas such as Socotra Island being declared malaria free and Hadramout classified as 'pre-elimination'⁴² due to concerted control efforts by the NMCP.

NATIONAL MALARIA CONTROL AND ELIMINATION STRATEGY (NMCES) 2014-2018

The NMCES marks the following as its overall objectives:

1. To reduce malaria morbidity by 75% by the end of 2018;
2. To reduce malaria mortality to nearly zero case by the end of 2015;

3. To make by the end of 2015, a major impact on transmission and reducing incidence to less than 1 case per 1,000 in all areas targeted for elimination.

Unfortunately, the ambitious plans laid out in this strategy have gone largely unfulfilled. This strategy was created to replace the 2011-2015 plan that had already begun to lag behind, with one paper stating in 2014 'Yemen is not on track to ... reduce global malaria cases by 75% by the end of 2015'⁴³. The context into which control programmes might be implemented has only become more complex.

The 2016 World Malaria Report shows figures of various control activities in Yemen up to 2015, depicting a steady decline in protective and preventative activities (table 29)⁷. The Global Fund website cumulative data for LLIN distribution shows no change between 2015 and 2016 thus it would appear that no LLIN were distributed by them last year⁴³.

Table 29: data taken from WMR 2016 showing various control activities used⁷

	No. of ITN/ LLINs sold or distributed	No. of people protected by IRS	No. of RDTs distributed	First-line treatment courses delivered (including ACT)	ACT treatment courses delivered
2013	1,405,837	2,204,429	233,311	303,847	303,847
2014	375,899	2,188,436	412,350	215,486	215,486
2015	847,946	798,707	334,525	153,682	153,682

Table 30: Overall reported Malaria cases by method of confirmation: 2000-2015⁷ to show downward trend over past 4 years. Data taken from the WMR 2016⁷.

	2000	2005	2010	2011	2012	2013	2014	2015
Presumed and Confirmed	1,394,495	200,560	198,963	142,147	165,678	149,451	97,089	95,287
Microscopy examined	-	472,970	645,463	645,093	685,406	723,691	643,994	529,932
Confirmed with Microscopy	1,394,495	44,150	78,269	60,207	68,849	63,484	51,768	38,254
RDT Examined	-	-	97,289	108,110	150,218	157,457	141,519	111,787
Confirmed with RDT	-	-	28,428	30,203	41,059	39,294	34,939	30,728
Imported cases	-	-	-	-	-	-	-	-

⁴² www.ncbi.nlm.nih.gov/pmc/articles/PMC4141094/

⁴³ www.theglobalfund.org/en/portfolio/country/?loc=YEM&k=a1313a6f-19ba-457f-b0eb-5ff2c5c55b6d

Given the disruption to planned malaria prevention services as a result of conflict and related breakdown of financial and administrative systems since 2015, it is unlikely that any communities reached in the most recent campaigns remain protected. All should be considered in need of protection and vulnerable to infection, according to the combination of natural and manmade risk factors. As reported in the first section of this report, the reduction in reported cases of malaria over the past four years (see table 30) seems somewhat unlikely given the ongoing security context, low percentage of the population with access to health services issues, lack of epidemiological reporting and minimal attention the disease has received in recent years.

Effects of malaria tend to be particularly severe for children, accounting for 17% of paediatric hospital admissions and 50% of cases in children <5 becoming complicated⁴².

The conflict has effectively pushed IDPs from regions of low risk to regions of higher risk and as malnutrition has become widespread and acute, the population's vulnerability to malaria will be rising. It must be assumed that IDPs have negligible, if any, protection. Furthermore, with the continued breakdown of infrastructure and programming under conditions of conflict, it cannot be assumed that previous achievements in reducing the geographical area of malaria transmission have been sustained. Rather, more recent research points to the emergence of 'new foci'⁴⁴.

The effect of conflict on disease control activities and its impact on water and sanitation services, alongside limited access to healthcare was brought into sharp relief by the emergence of a Dengue Fever outbreak in week 33 of 2016, located in Aden, Lahj, Al Hudaydah, and Shabwah⁴⁵. Whilst the vector for Dengue is not the same as that of malaria, it is under similar adverse conditions that previously well controlled regions of endemicity can regress to see uncontrolled outbreaks of a disease. A recent epidemiology report (08/2016) highlights that malaria remains the fourth cause of morbidity, demonstrating that this risk should not be underestimated.

NMCP

NMCP has experienced severe funding shortages since the scale up of the current conflict, and this has significantly impacted on their staffing, ability to maintain and monitor disease surveillance systems and reduced their operational capacity. However, despite these major challenges NMCP has remained committed and has found some more limited ways to continue their activities and to adapt in part to the emergency context. In so doing, it has managed to maintain much of its basic structure, if not all of its functionality, and demonstrated its continuing ability to mobilise large scale campaigns (described below) for LLIN and IRS roll out in 2016 and 2017. NMCP has sub-offices in all four of the priority governorates and it is these that are responsible for the distribution of ACTs and RDTs to public health facilities in coordination with district health offices. One of the difficulties that NMCP has experienced as a result of reduced funding to them, is that the performance of the sub office system for supply chain and surveillance has been significantly reduced and NMCP sub-offices have struggled to sustain the flow of the supplies to HFs. In response to this problem NMCP have worked with WHO, who has supplied emergency drug kits, transporting and storing these in GHOs district stores. The NMCP sub office coordinators have then distributed the kits (Coartem tabs and Artesunate injections) to the targeted HFs as part of their ongoing responsibility for malaria commodity supply chain support. In this way NMCP have managed to support some of the health NGO (e.g. MSF) partners with essential stocks, for hospitals and other health facilities which they are helping to support. Currently, Save the Children are the only NGO involved in malaria prevention activities in Yemen (UK DEC 02/06/2017) and there is an urgent need for more malaria control partners. However, it is important to note that most NGOs that are supporting primary health care are also engaged in various ways with supporting basic malaria and diagnostic treatment centres. However, out of the 4 governorates discussed in this report, Save the Children are restricted to working in Taizz alone.

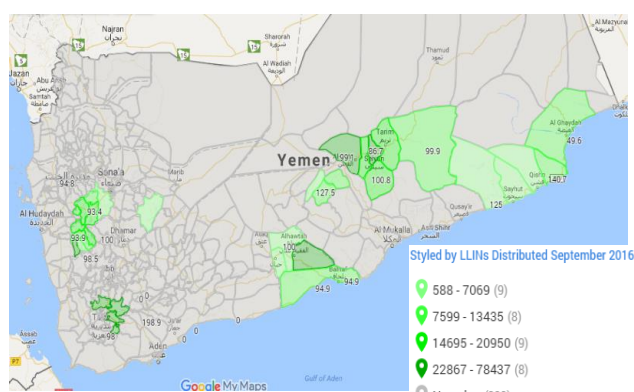
⁴⁴ <https://parasitesandvectors.biomedcentral.com/articles/10.1186/1756-3305-7-351>

⁴⁵ www.emro.who.int/images/stories/yemen/WHO_Yemen_situation_report_Issue_33_-_August_2016_final.pdf?ua=1&ua=1

LLIN AND INDOOR RESIDUAL SPRAYING ACTIVITIES

WHO advocated for a scaled-up general health response in March 2016, detailing the arrival of 103 tonnes of antimalarial medicine, trauma kits, emergency health kits and diarrhoeal disease kits at Aden port, with an additional 120 tonnes set to arrive shortly afterwards⁴. The report also requested IRS to be implemented in Al-Hudaydah, Abyan, Aden, Taizz, Hadramout, Shabwah, and Al-Mahra. It cites a growing concern with the *'increasing number of malaria cases in Yemen, especially among internally displaced persons (IDPs) who need increased protection'*⁴.

Figure 72: MoPHP records of LLIN distributions from September 2016 (Annex 1a)



Since the March 2016 WHO report, the WHO and NMCP have delivered two rounds of LLIN distributions (see Annex 9) in September (table 31 and figure 72) and October (table 32 and figure 73) 2016 and an IRS campaign in 2017 with the following coverage:

Table 31: Data by governorates for Phase 1 LLIN distributions. MoPHP data from September 2016.

Phase 1	GOV	Targeted districts	Pop. Covered	No of LLIN
1	Rima	6	206,439	103,218
2	Sana'a	6	128,444	64,222
3	Taizz	6	547,069	273,535
4	Shabwa	4	98,582	48,998
5	Almahrah	5	68,300	34,150
6	Hadramout	10	310,000	155,000
Total		37	1,358,834	679,123

The maps (figures 72 and 73) above show the geographical areas targeted by the latest rounds of LLIN distributions and tables 31 and 32 gives a more global overview of governorates targeted and beneficiaries within this. The numbers on the map give the percentage of planned distributions that reached targets over both distributions, and the maps show coverage by district for the September and October distributions respectively. Only Taizz, out of the four priority governorates, has had any level of coverage (approximately 20%), leaving the need for targeting these areas largely unmet.

Table 32: Data by governorates for Phase 2 LLIN distributions. MoPHP data from October 2016.

Second Phase	Governorate	Targeted Districts	Population Covered (estimated)	No of LLIN
1	Ibb	4	374,168	187,084
2	Dhmar	7	294,764	147,382
3	Almahweet	6	274,240	137,120
4	Abyan	2	0	0
5	Lahj	8	365,456	182,728
6	Al Dahlee	5	0	0

In addition to LLINs campaigns the NMCP has also recommended IRS as 'the most important intervention' to prevent the spread of malaria. Using Bediocarb, a carbamate pesticide, chosen due to the vectors' susceptibility in the region to this chemical, NMCP have delivered a large IRS campaign that targeted 124,361 households (938,559 individuals) across 6 governorates in 8 regions (figures 74 and 75 and tables 33 and 34) in March and April 2017 (Annexes 10 and 11). The sites targeted through a spraying campaign carried out in March 2017 are more in line with those highlighted in this report priority governorates in terms of disease burden, predominantly situated in Al Hudaydah and Taizz.

Table 33: Target with the completion of the spraying campaign in the pesticide remaining in March 2017 according to location

Targeted Area		Protected Population			Quantity of Pesticide in kg			Number of Houses			Number of Rooms		
Regions	Governorate	Target	Protected	%	Custom Pesticide	Consumer Pesticide	% Ratio	Targeted	Sprayed	%	Targeted	Sprayed	%
Wadi Siham	Al Hudaydah	132,501	106,927	81	722	679	94	17,604	16,419	93	43,028	41,959	98
Al Garahi	Al Hudaydah/Ibb/Dhamar	126,412	63,486	50	779	636	82	15,245	13,834	91	40,592	34,131	84
Zabid	Al Hudaydah	135,826	35,586	26	813	417	51	15,889	8,134	51	39,582	20,816	53
Wadi Ruma'a	Al Hudaydah	173,665	99,293	57	1115	1075	96	22,157	20,562	93	61,191	59,341	97
Wadi Sardoud	Al Hudaydah/Al Mahweet	188,351	123,603	66	1224	1480	121	25,696	23,066	90	67,386	67,797	101
Wadi Nakhla	Taizz	68,364	35,115	51	413	356	86	9,534	8,189	86	23,161	19,303	83
Makbneh	Taizz	66,045	37,485	57	428	325	76	9,435	7,752	82	26,939	22,735	84
Ibb	Ibb	47,395	50,819	107	482	444	92	8,801	8,241	94	33,064	34,014	103
Total		938,559	552,314	59	5976	5412	91	124,361	106,197	85	334,943	300,096	90

A follow up IRS campaign was carried out in April 2017 with the following coverage:

Table 34: Target sites for second round of IRS, April 2017

Location		Protected Populations			Households			Rooms			Quantity of Pesticide in kg		
Site of Spraying	Governorate	Target	Protected	%	Target	Protected	%	Target	Protected	% Ratio	Custom Pesticide	Consumer Pesticide	%
Sa'ada	Sa'ada	115,821		0	16,039		0	46,970		0	802		0
Aslam	Hajjah	113,939	99,499	87	17,256	17,598	102	40,753	40,748	100	783	729	93
Wadi Mawr	Hajjah	124,845	89,467	72	17,835	16,224	91	42,804	37,712	88	856	849	99
Ash Shaghadirah	Hajjah	48,299	53,051	110	9,201	9,514	103	25,733	26,099	101	434	546	126
At Tur	Hajjah	53,353	45,365	85	9,074	8,391	92	21,398	19,946	93	437	499	114
Al Luhayyah	Al Hudaydah	112,232	62,638	56	13,712	11,974	87	32,907	32,642	99	617	736	119
Al Mahweet	Al Mahweet	45,480	41,971	92	7,269	7,061	97	26,453	28,690	108	414	418	101
Al Maghrabah	Hajjah	46,466	41,060	88	6,638	6,570	99	17,923	18,727	104	294	371	126
Haradh	Hajjah	75,612	72,156	95	11,120	13,051	117	26,653	28,764	108	533	481	90
Khayran Al Muharraaq	Hajjah	87,652	71,120	81	10,561	11,432	108	28,321	25,922	92	504	477	95
Ku'aydinah	Hajjah	64,145	53,171	83	8,900	8,688	98	26,700	23,129	87	445	396	89
Mustaba	Hajjah	109,477	86,411	79	15,968	14,675	92	44,390	37,298	84	797	649	81
Total		881,500	715,909	81	127,534	125,178	98	334,035	319,677	96	6,114	6,151	101

Figure 74: Map showing target sites for IRS (green) and sprayed sites (red), March 2017 after the 1st day's implementation.

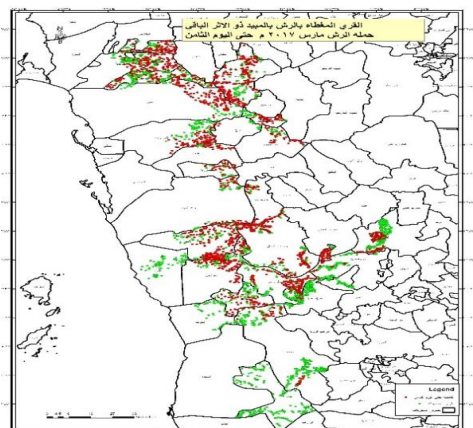
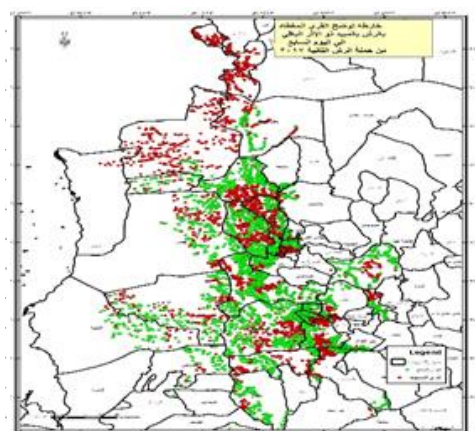


Figure 75: Map showing IRS coverage, green dots show reached sites and red dots are those targeted, April 2017 (halfway through implementation period).



In total, for the two campaigns, 13 tonnes of pesticide have been used and 2 tonnes remain in country. 600kg of the remaining pesticide has been sent to Hadramout malaria regional office to be used as emergency stocks for spraying of outbreaks.

The information received and researched is subject to errors and gaps of underreporting due to the complexity of the current situation in Yemen. This can help to account for apparent contradictions in the data available. Numbers, for example, collated from the World Malaria Report 2016 describe a

decrease in both incidence and mortality rates of >40% for malaria⁷ over the past four years yet reports of various outbreaks and concerns around rising caseloads of malaria are widespread. It is for this reason that in addition to basic malaria case data this report uses a wide range of entomological, geographical, socioeconomic, and various human factors to explore how these interact and increase or decrease the risk of malaria for affected communities. Security is a major factor and has direct consequences for malaria and health service provision.

RECOMMENDATIONS FOR MALARIA CONTROL

FRAMING THE CHALLENGE

The MoPHP /NMCP developed well defined and logical plans for malaria control in Yemen prior to the outbreak of the conflict that now affects many parts of the country. Whilst the pre-conflict national malaria control plans have become unrealizable in the current context, important capacity and infrastructure and systems have nevertheless been built and, to varying extents, remain active in the assessed governorates. Access for NMCP and NGOs to some geographical areas is frustrated by insecurity and limited resources and national health services and their support systems (including the supply chain) have now become severely compromised. This has resulted in many communities unable to access basic health care at a time when their need for health services is at its greatest. It is clear that establishing an effective way forward in the current crisis remains critical. This may require more innovative and targeted approaches to meet the specific needs of those most at risk from malaria and other vector borne diseases. It is also apparent that there is a lot of capacity available, if mobilized and supported, to deliver the action needed for 2017 and 2018, including targeted support to some of the important systems such as supply chain and disease surveillance. The basic lack of malaria and other health funding for Yemen has also played a significant role in the reduced scale of malaria control services available to the most vulnerable communities. This can, in part at least, be tackled with smart planning of currently available resources.

Domestic funding for malaria control ceased in September 2016; Global Fund decreased its support and the GCC grant for Malaria was suspended and dedicated staff have gone unpaid for many months. These are all predictable consequences in countries that experience largescale conflict, as development based funding is often ill adapted administratively, or technically in mandate, to adjust quickly or at all to suit the conflict situation that evolves. However, hiatus in funding support of all forms, for any sustained period, adds to the problems for running even basic activities such as supply chains, access to basic diagnosis and treatment services and

basic disease surveillance and epidemic response systems. These are all evident challenges for the governorates that are the subject of this report. Deterioration in physical security, access to static health systems, population displacement and food insecurity have significantly increased the risk of the most vulnerable communities, recorded across the governorates. Reported numbers of malaria and dengue fever cases in 2017 confirm this and are extremely concerning. Responses need to be tailored to control malaria and, where possible, investment used to also aid the surveillance and control of dengue fever and other diseases in the governorates where the disease burden is highest, and potentially beyond.

It should be noted that, when national staff are unpaid for more than a few months, morale is low and systems for which they are responsible for maintaining become fractured. In parallel with the scale up of international organizations, an inevitable “brain drain” of the most qualified staff from national systems into UN agencies and NGOs occurs. This can exacerbate some of the problems of maintaining centralized systems, such as drug supply and HF supervision and support. Whilst an understandable consequence of crisis situations, good staff need to be retained and supported in MoPHP and other ministries, wherever possible. If coordination is to be maximized during the crisis period and effective development of the health care systems achieved to assist the country long after the return to peace and stability, this must be a priority.

SURVEILLANCE

In most conflict settings, surveillance data tends to be skewed to be more representative of the more accessible urban communities and less representative of rural, village-based communities. This is likely to be the case in the governorates that are the subject of this assessment and therefore, the data is likely to understate the malaria burden. With so many health facilities out of order it is difficult to have a clear view on malaria prevalence in the governorates that are included in this report. As stipulated in the HNO 2017, continual and systematic collection, analysis and interpretation of health data

remains essential to the planning, implementation and evaluation of health interventions. Only a functioning surveillance system is able to monitor trends, provide early warning of an outbreak and monitor the effectiveness of malaria control interventions and/or define priorities.

An adequate malaria surveillance system was established at the end of 2009, mainly under GF funding. Data collection and processing was up to speed during the first three years and instrumental in determining the endemic areas, disease trends and the progress of the malaria control in that period. However, by mid-2014 GF activities support was suspended and in time, the data collectors stopped sending reports. At the end of 2016 the system had collapsed. The NMCP currently depends on the e-DEWS system to follow the disease trend on the ground and, though this is helpful, there are important gaps in the system that need to be covered. This system is based on an early warning component only and is not fully operational in the country. But at the moment it is the only source that submits weekly epidemiological data by proxy and as such indispensable.

The statistics used in this assessment obviously represent only part of the challenges on the ground. Therefore, accepting the limits of the malaria data, this assessment has reviewed all malaria data until the end of 2016 and the first quarter of 2017 (thanks to the NMCP Yemen) that have been made available to date. The data used has been combined with information on factors likely to complicate or exacerbate malaria transmission and risk amongst vulnerable communities, to inform recommendations on case management and prevention activities. This is the basis of justifications of a program of targeted interventions that will have the biggest possible impact on malaria control in the governorates assessed in this report within the limitations of the current funding and will undoubtedly help to identify additional funding in the year to come. An important part of this will be surveillance activities to improve data collection as the programmes progress.

CURRENT AND PLANNED ACTIVITIES

Despite the obvious frustrations, limitations and challenges faced, the NMCP remains committed and, with support from WHO, IOM and other partners, was able to plan and deliver impressive

scales of prevention campaigns in 2016 and early 2017, as reported in earlier sections of this report. As part of that work in 2016 NMCP distributed 1,524,982 LLINs in 12 governorates (6 in the South and 6 in the North). Through these campaigns NMCP also proved successful in their ability to mobilize staffing, recruiting 1,465 short term campaign workers including mobilizing 217 of their own NMCP staff, 179 GHOs staff and 1,069 DHOs distribution workers. In 2017 the focus shifted appropriately (in our view) to delivery of targeted IRS campaigns to help target and protect most of the IDP communities. In addition, the NMCP has managed to maintain sub offices in priority governorates and some degree of functionality at sub office level, with important support from GF and WHO. These offices provide an important established delivery route for entering malaria commodities into the supply chain and helping to distribute these from governorate and district level storage sites to the targeted HFs. These sub office teams have also proved able to play a central role in delivery of large scale prevention campaigns in 2016 and 2017 to date, despite the funding and staffing limitation that they work under. These examples demonstrate the commitment of the country partners to adapt as far as feasible, with the very limited resources available, to try and meet the apparent needs of the population, providing an encouraging partnership for the next phase of the responses now needed.

That partnership remains very important as the country is now heavily dependent upon support from international and local NGOs, UN agencies and donors to deliver essential services and reach the most vulnerable communities. This brings with it the challenges of meaningful coordination to maximize the resources available, minimize wastage and avoid duplication of efforts, when humanitarian funding is limited and there is no clear sight of an end to the current conflict. In addition to the huge challenges presented by the current setting in Yemen, the use of GF funds has to be prioritized within very tight financial and material constraints and in a setting of complex and reduced accountability. If planned well and coordinated clearly, the gaps that GF funds cannot reasonably cover should be clear and definable. This should subsequently aid the lobby process for other donors who may be able to provide specific emergency support in the short term to plug the gaps for malaria response needs of some of the most acute types.

PRIORITIZATION OF NEEDS

There are different tiers of beneficiaries that can be reached through the use of the 7M USD 2017 budget, if delivered very carefully and targeted. To target more specifically beyond governorate level, prioritization of needs should focus on identifying beneficiary groups. This should aim to identify those most vulnerable to developing severe clinical disease out of those at risk of contracting malaria based on the three main risk factors already identified: transmission risk, displacement and nutritional status.

When these filters are applied, we suggest that the following beneficiaries should be prioritized for GF targeted support with the limited resources available:

1. One of the target beneficiary groups are internally displaced, returnees and resident communities living in higher malaria transmission settings. Whilst young IDP/returnee children (55% of the total displaced) may prove to be the most at risk, all IDP age groups in this setting will be at increased risk compared to where they originated from. But it remains highly recommendable, in a setting where internally displaced are intertwined with the resident population (even if they live in spontaneous settlements), to provide services to the community as a whole, to avoid preferential treatment and subsequent conflict on social and political levels. Almost 90% of the population who have returned from their displacement in the last two years have returned to 33 districts. Geographically this represents just 10% of the 333 districts in Yemen, and therefore suggests that clear pockets of return, in areas of relative stability, may become more manifest. Of the total returnee population, an estimated 85% (around 750,000 individuals) have returned from displacement areas situated within their governorate of origin (15th TFPM report, July 2017).
2. Local resident communities living in high malaria transmission settings, especially Al Hudaydah and parts of Hajjah. There will be significant overlap in recommendations for beneficiary groups 1 and 2.
3. Communities in high to moderate malaria transmission areas that currently have very poor access to, or poor utilization of static health services for diagnosis and treatment of confirmed malaria cases. The best recommendable approach here would be to reinforce the community health care approach through Community Volunteers (CV's) in targeted districts.
4. All children and adults suffering from severe malaria.
5. Local communities and/or IDPs living in low malaria transmission areas that experience epidemics of malaria. In this case, all age groups will be at risk of malaria (with the exception of IDPs over the age of 5yrs who have originated recently from high malaria transmission areas).

GEOGRAPHIC PLACEMENT

From national data, the main burden of malaria in Yemen clearly lies in the 4 governorates already specified above (Al Hudaydah, Hajjah, Sa'ada and Taizz). The population at risk of malaria however, extends beyond this, present across the north and western coastal areas, known as the Tehama region, and in some governorates that are located in the south of Yemen. In order to allow for a malaria control program that addresses the areas with the highest burden, efforts have to be made to assign proportionate financial resources to the north-western and southern part of Yemen to implement malaria control activities providing comprehensive coverage across the country. With this now wider geographic area included in the report, tailor-made interventions appropriate for each region can be suggested in a proposal that should than find no trouble in being endorsed by authorities in Sana'a and the official government in Aden. In depth discussion in the report of the major risk factors (transmission risk, displacement and nutritional status) and their presentation, specific to each area identified, provides justification for the choice of and weight of importance given to the interventions based on geographic placement.

BENEFICIARY GROUPS 1 AND 2: Internally displaced, returnees and resident communities living in higher malaria transmission settings

Recommendation: Ensure Full prevention (LLIN) and Case Management Services

PREVENTION SERVICES

Those most at risk of malaria, malnutrition and exposure to other diseases are those who are displaced from their homes and communities of origin, for many months and forced to flee conflict to seek temporary shelter in ad hoc (makeshift) settlement sites, warehouses or with families in other communities. As they return to their places of residence, they often find their houses destroyed and their sources of income seriously compromised. As malaria rates are highest in Al Hudaydah and Hajjah and some areas in Taizz, here the IDPs/returnees and related host communities represent the bulk of those who need priority support on the level of malaria control. But in a situation where health surveillance has become an enormous challenge, it is very difficult to have a complete picture of malaria prevalence and vulnerability in Yemen, hence, other areas that have shown significant numbers of confirmed malaria cases in the past (NMCP statistics 2010-2016), should be included in the GF supported program, most notably areas the Tehama region and the south.

Operational and Technical Notes

1. IDPs in Yemen are predominately hosted in the homes of local families and communities so the services targeted towards IDPs must not be seen as separate from hosts. Hosts' needs will be similar to IDPs' and their coping mechanisms will have been overstretched in many cases.
2. Those living in areas with lower transmission risk for malaria, in which the level of nuisance insects and malaria infected mosquitoes will be relatively lower, potential uptake and sustained use of LLINs is likely to be more challenging to achieve. The MIS 2013 report highlighted a significant problem of low usage amongst LLIN recipients in peace time. Therefore, careful targeting of LLINs to areas with

highest incidence of disease and nuisance insects in the current emergency is important, as well as sensitisation of these communities may be more successful.

3. We recommend that IRS be used preferentially for communities living in the higher ground/altitude urban settings (especially where these communities have prior poor usage experience with LLINs) and in response to malaria or leishmaniasis outbreaks.
4. Wherever LLIN or IRS is successfully delivered and the community acceptance and usage is high and sustained, risk of infection from Leishmaniasis or Lymphatic filariasis will simultaneously be significantly reduced. The vectors responsible are controlled by these same tools/strategies. This will have particular value in Al Hudaydah (endemic for both) and Taizz (coastal parts are endemic for both).
5. Many of the easier to reach communities may have received LLINs in the September/October LLIN distributions. If these LLINs remain in serviceable then these communities should not need to be included in the next round of LLIN distributed or as targets for IRS, unless the LLINs are shown not to provide the protection needed. Their condition should be validated.

Recommended Modes of Delivery for LLINs & IRS

The proposed beneficiaries represent high priority groups for the humanitarian clusters, as many vulnerability factors converge with IDPs and host communities in high risk transmission areas (shelter needs, WASH needs, nutritional needs, and health care services). The partners for each of these clusters are listed in the report sections above. NMCP have demonstrated an important capacity to delivering LLINs in 2016 reaching further into governorates than might be anticipated within the security setting. Access for NMCP teams does vary, as it does for NGOs and UN agencies, will continue to vary with changes in security in the months ahead. However, both NMCP and NGO implementing partners have different advantages and disadvantages currently, in terms of access and acceptance at community levels and the respective advantages of each should be maximized and used to make future

LLIN distributions a success. NMCP has highlighted problems with low LLIN usage generally amongst LLIN beneficiaries, and this is a common problem in many similar settings. It underscores the importance of ensuring that all LLIN distributions are preceded by, accompanied and followed by, sustained IEC with standardized messaging aimed at enhancing understanding of malaria, retention and correct usage of LLINs, and maintenance of LLINs, by those who receive them. Where ever possible this should be combined with physically delivering LLINs to individual households and assisting the household to hang the LLINs above their sleeping areas as the gold standard for LLIN campaigns. In conflict zones this is rarely achievable and alternative, less ideal methods must be chosen from. Community based LLIN distributions are the second best approach to take, but still require considerable dedicated logistics and HR. NMCP has been successful in mobilizing community distributors for previous LLIN campaigns, and some NGOs have had similar experience with other distribution types. NGOs also employ community based labourers to serve as the short term commodity distributors for most campaigns, operating in the same basic manner.

In the current context, we recommend that NMCP and NGOs with operational experience and infrastructure in targeted areas of the four governorates and their specific target districts/ areas, work together to ensure joint planning for all LLIN distributions. Then, according to the access each partner might have for a given geographic area, once basic planning and target beneficiaries have been agreed, the partner deemed to have the best access and ability to deliver at ground level, be supported and funded to take the lead on the campaign delivery. Where an NGO is deemed to be the best suited to delivering the LLINs, NMCP should receive basic support to ensure their ability at national and governorate/district levels to facilitate (as far as feasible) the NGO partner, politically and logistically (such as use of NMCP or other MoPHP warehouses, etc.). IEC materials/resources should be standardized and supplied in adequate quantity for the respective campaigns, regardless of who actually delivers the LLIN campaign. We recommend GF funding support as needed to ensure this, as part of the package. This joint approach to LLIN and IEC campaigns will enhance the NMCP capacity to meet its aims, increasing access to some areas and communities, and increase LLIN monitoring and evaluation potential. Potential international NGOs available to partners with NMCP include those

listed in the table below, though we recommend partnership with credible national and local NGOs (of which there are currently more than international NGOs where possible, as this will increase acceptance at community level and provide some capacity building for local NGOs also.

We recommend that all LLINs, by which ever method they are delivered with, are removed from their packaging and are marked with an ID (in permanent marker), to discourage resale, whilst also ensuring some level of contact to explain how to hang and use the LLIN. Opportunities to enhance LLIN distributions in some areas (depending upon timing) may include coordinating with WASH programmes that are being undertaken over a period of time in communities, shelter projects, education projects/schools, plus static services such as SAM and MAM treatment points, and health facility delivery to patient families. The relative value of each of these will vary on a case by case basis. We recommend that LLIN are not distributed as part of routine NFI distributions. These have proved generally flawed in most countries, resulting in low LLIN retention and usage, for multiple reasons (i.e. lack of prior and ongoing sensitisation about the need for LLIN and correct usage). This distribution method often means they are delivered in their packaging making them a high value commodity that can then be easily resold and making it difficult to ensure even basic demonstration of how to hang and use LLINs during NFI distributions, there is no follow up mechanism.

IRS is the more appropriate tool to use in some settings, and will prove particularly valuable as the means of prevention for IDPs living in settlement buildings (warehouses, temporary structures, etc.) *(and for urban living communities (local and IDP) in higher altitude locations at risk of, or in the event of early stage, malaria epidemics)*. In such settings, IRS is the WHO recommended first line tool for epidemic prevention and control, as it can be rolled out rapidly and at scale. To be effective and safe, IRS takes considerable logistical and technical management and monitoring, but will achieve effective disease control for malaria and leishmaniasis.

In these cases, we recommend that NMCP co-ordinate the IRS responses, as it has established some good IRS capacity and has experience of IRS planning and delivery in this setting. Use of existing trained staff at supervisor and sprayer levels should be maximised, and NMCP should partner only with IRS experienced and skilled NGOs, to ensure

delivery of IRS campaigns, to ensure that quality of IRS delivery and monitoring is held at an acceptably high standard. Given the limits of available published data from Yemen, we recommend support for annual monitoring of insecticide efficacy using standardized WHO protocols for bioassay, plus CDC bottle tests, as a minimum approach to ensuring insecticide efficacy is monitored and data is available to help inform any future consideration for changes to insecticide classes used in Yemen (this will inform both IRS and LLIN strategies).

MALARIA CASE MANAGEMENT SERVICES

We recommend that routine malaria RDT and drug supply chain support for the identified governorates be assured in two ways in order to compensate for the access limitations that the current security imposes and the functionality challenges that supply chain systems are under. Priority must be given to maximize regular deliver of malaria case management commodities to the health service level. This should be done in a balanced manner based on estimated malaria case-loads, in order to minimize risk of stock outs of essential RDTs and drugs. It should be noted that to minimize the risk of health workers having no alternative therapies for non-malaria cases (a risk of sole disease supply chains), efforts should be made to inform and co-ordinate with functioning supply chain systems for all essential supplies going to the health system. In the current crisis, close cooperation with INGOs is recommendable.

Supply Chain System 1: A portion of GF support and malaria case management commodities should be provided to NMCP to fuel their supply chain system, where ever the level of functionality is adequate (or can be made adequate), and where the NMCP sub office has the access to ensure onwards distribution to health facilities in the surrounding area. This will ensure the supplies pass to NMCP Sub-Office stores, or other MoH stores, in each of the governorates (in quantities that are in line with the malaria case-loads and seasonality described in the earlier sections of this report, for each location). Supporting the centralized supply chain system in proportion with its level of functionality, ability to reach health workers, and accountability has many advantages in the short and long term, if this is well managed.

Supply Chain System 2: There are and will be, areas of the four priority governorates that present constant challenges to physically reach, and in some

cases, where NMCP sub offices simply cannot reach, either on a temporary basis or an ongoing basis as a result of insecurity. For this reason we recommend that the supply chain system be supplemented with the aid of the Health Cluster partners. By enlisting the 18 health NGOs that support (in various ways) health care facilities. Malaria case management commodities can be donated directly to NGOs operating support to areas outside of the regular reach of the centralized supply chain system, until such time as the central supply chain system can obtain and sustain full access. The health NGOs can take receipt of donated supplies at their country HQ levels, or at governorate warehouse levels, in order to cut down logistical and administrative steps. The NGOs can then incorporate the stocks directly into existing health programme activities. This would reduce distribution cost implications, avoid duplication, and potentially improve data reporting and better link HF restocking according to recorded usage requirements and ensuring delivery on a regular basis. This approach would complement and not compete with the centralised supply chain and distribution systems (where these are functional), to help minimise stock outs. Prioritisation for Al Hudaydah is currently needed, given that this governorate has to date (2017) suffered the overwhelming burden of malaria cases. Health partners operating within this governorate include: ACF, ADRA, IRC, QCRC, SCI, ADO, MMFY and Yamaan. Where health NGOs receive direct donations of commodities to deliver themselves, they should be provided with standardized gift certificates and templates for data collection and reporting.

We recommend that NMCP, WHO (plus a specialist NGO if needed) assist to standardise availability and distribution of standardised malaria case definitions, treatment protocols and data collection forms used by health partners. This activity should also be used as an opportunity to reinforce case recording quality in the health facilities, through simple checks undertaken at each health facility on the day that the supporting NGO is present for other activities. This will help to ensure resupply of facilities with RDTs and drugs as need indicates. All data collection enhanced through this approach should be reported back to NMCP for collation to avoid duplication of data reported directly from health facilities to NMCP to reinforce and improve epidemiological surveillance.

BENEFICIARY GROUP 3: communities in high to moderate malaria transmission areas that currently have very poor access to, or poor utilization of static health services for diagnosis and treatment of confirmed malaria cases.

Recommendation: Significantly augment access to diagnostic and treatment services at community level, prioritizing communities whose access to, and uptake of, static health facilities is very low.

This Beneficiary group will overlap with Beneficiary groups 1 and 2

Functionality and access/usage of MoPHP static health services have been severely compromised and so, alternatives to regular service delivery should be considered to reach vulnerable populations. In order to effectively overcome the various security, geographic, financial and gender access barriers now facing communities in the worst affected areas, the expansion of Community Health Volunteer (CHV) networks is recommended. CHVs should deliver a basic package of health care and IEC interventions, including MUAC screening, malaria diagnosis and treatment of uncomplicated cases, pre-referral treatment of suspected severe malaria cases and referral of these cases and other patients in severe conditions. These should be prioritized in areas identified in this report where utilization rates of static MoPHP health facilities are low and malaria infection risk is high, such as much of Al Hudaydah.

Support and capacity building within the health care system remains very important, but developing access to malaria diagnosis and treatment for those beyond the reach of static health facilities is vital. Ensuring access to malaria treatment for confirmed cases (especially young children in high transmission areas) at community level through CHV networks is an important strategy for reducing the malaria burden. If well delivered and supported this intervention can significantly reduce the proportion of severe malaria cases and malaria related death rates, whilst also addressing other basic health needs and expanding nutritional screening. Thus, community based health care by volunteers is globally recommended as an important way to deliver basic health care services in conflict zones where access is very much compromised. CHVs will be trained in ICCM services to deliver at community

level on an estimated frequency of one to every 50-100 children under five, as well as diagnosing and treating adult cases of malaria. Diagnosis will be through the use of RDTs and treatment of positive cases will be by ACTs. In severe and complicated cases, positive cases will be treated using Artesunate suppositories and referred on to the nearest health center or hospital with admission services. Each CHV will be linked to their nearest health center where functioning. Stock replenishment and data reporting will either be direct to the health facility or via the district CHV supervisor, depending on the local security and infrastructure context.

Many of these networks have existed in various forms and have been particularly extensive in supporting nutritional services at community level. Since 2009, these networks have also provided basic health education, been instrumental in related distributions and been an initial point of diagnoses and referrals onto health centers. In 2011, the role of the CHVs was formalised to include health and nutritional education, provision of vitamins and nutritional supplements and management and prevention of diarrhoea, pneumonia and malaria. MoPHP, supported by JICA and UNICEF, enabled this by producing 3 training manuals covering the following:

- **Part 1:** Education and communication, nutrition/malnutrition, maternal health (including breastfeeding), infections and helminths.
- **Part 2:** Malaria, diarrhoea, pneumonia and malnutrition (anaemia).
- **Part 3:** Family planning and growth rates.

Since these training manuals were developed, >11,000 CHVs have been trained on basic health needs, covered in Part 1. This includes diagnosis and referral of acute malnutrition onto TFCs and HFs. However, despite a well-established national guiding policy (2016) the CHVs have not yet received Part 2 training and are therefore not mobilized and equipped to provide community based diagnosis and treatment of malaria and other infections.

Of the 11,000 qualified CHVs that have been trained on part 1 of CHV training manuals (nutrition and communication) 25 should be selected from each of the 20 districts, to serve their local communities. An equal mix of female and male CHVs should be selected, as far as is feasible. CHVs should be trained

in Part 2 as per the existing NMCP and Nutrition Programme existing and approved manuals, and equipped with the basic materials (kit bag, agreed IMCI contents, plus malaria RDTs/ACT, rectal artesunate (for pre-referral treatment of severe cases) plus MUAC tape, record sheets, etc.). CHVs provide consultation and treatment services free of charge, and will record patient information in written and digital form, using software on their mobile phones designed for data entry of cases. Mobile phone data entry allows for weekly reporting to the server, tracking use of commodities for timely stock replenishment and strengthening of community disease surveillance through notification of each of the three diseases. By strengthening communication between ICCM and CHVs mobile phone data entry also allows for sharing information, experiences and key technical and IEC messages through the CHV networks.

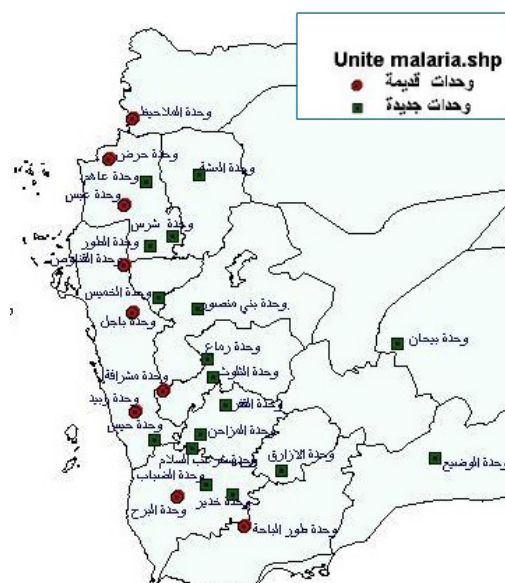
A basic supervision system suited to the current insecure contexts in which the CHVs are serving must be established, with a joint coordination mechanism (i.e. NMCP, Health Cluster, Nutrition Cluster) and an implementing partner(s) need to be identified to ensure the regular supervision and maintenance of the district CHV networks. Each District CHV network will require a district level supervisor for the 25 CHVs. The supervisor will be responsible for meeting regularly with each CHV to check and collate the patient registers, compare these with RDT/drug utilization rates, and then resupply the CHV according to the local need, and make support payments.

Governorates level CHV Programme Coordinator will be required for Al Hudaydah and another for Hajjah, as these governorates are very large and will have many networks. The role may be best served by an NGO partner to manage the CHV networks as the Coordination at governorate level will need to both ensure the overall quality of the CHV networks, facilitate their periodic refresher training, and ensure the overall collation and analysis of epidemiological and referral data. The Coordinator will also act as the vital linkage point between the CHV networks and the MoH/NMCP/Clusters both in terms of the supply chain from Governorate to CHV supervisor levels, and the flow of data from governorate to MoH/NMCP/Cluster levels. Supplies for CHVs will be oversighted at central level and transported to governorate level through the regular MoPH supply chain mechanism. Onward supply from governorate levels stores to district level supervisors may require

local solutions using existing NMCP/MoPH and NGO transport and supply mechanisms. We recommend that ACTs and RDTs, sufficient for 20 districts, are supplied under the GF (IOM) grant for 2017 and 2018, with a cross donor review late in 2018 to confirm strategy and partners for 2019 onwards. Medical supplies for diarrhoea and pneumonia, etc., plus Muac strips, should be provided separately by MoPH, UNICEF, WHO under the IMCI programme. We recommend that CHV supervision visits are initially bi weekly if possible, to ensure maximum support in the establishment phase.

The NMCP has suggested that the following channels/mechanisms can be used to establish ACT/RDT supply chains to community level:

- The NMCP will be responsible for transporting ACTs/RDTs to NMCP stores at GHOs and malaria units, seen as red dots (old units) and green squares (new units established 2012) on the map, at district level. Each unit covers an area of 3-5 districts.
- 3 of these units (one each in Sa'ada, Al Hudaydah and Hajjah) have been destroyed, due to conflict, but there are 14 still functioning in the Tehama region and 9 in southern governorates.
- ACTs/RDTs/ICCM commodities can be stored in these units to replenish DHO stores and/or distribute commodities directly to CHVs either during quarterly supervision or training meetings or when local HFs are restocked.



CHVs will need to be paid a standardized level of remuneration of services are to be maintained in the medium to longer term. Based on experience in other countries, 20 USD per week may be the minimum. This will best be fine-tuned by the co-ordination partners and needs to be agreed to ensure that it is in line with comparable services/pay, etc. Once established and operational in their districts, CHVs and supervisors may also assist NMCP, nutrition and integrated management of child illness (IMCI) programs for other community control and prevention activities, such as LLIN distributions and IEC campaigns. Motivations and compensation for these campaigns should be organized by the programs separately. Detailed budgeting will need to be developed on the ground as part of detailed CHV coordination with key partners. Various partners will be contributing different aspects and commodities towards mobilizing these networks at Phase 2 level. However, as a basic indication MENTOR run a comparative set of CHV networks in Central African Republic, serving a population of around 700,000 people with 220 CHV, in a remote and logistically challenging area of the country, of whom only 10% have access to static MoPHP health facilities. The global cost of delivering, supplying and managing the program is in the order of 2 million USD per annum, including the full supply chain costs for malaria, non-malaria and nutritional commodities, HR from delivery to supervision, to governorate coordination units and through to national management, and all transport and operational costs. Given that this example is an internationally run emergency program with very heavy reliance upon international staffing, the costs in Yemen, where levels of national staff capacity are generally good, could be significantly lower. An estimate of \$2-2.5/per person in the population areas served/per year, is likely to be reasonable, but will require local detailed planning with partners.

BENEFICIARY GROUP 4: all children and adults suffering from severe malaria

TO RECEIVE: Improved access to effective pre-referral treatment for severe malaria and effective full-course case management of severe malaria.

Malaria deaths occur as a result of the clinical disease developing unhindered and becoming severe. Cases then either reach treatment and survive or die through lack of timely access to effective treatment and poor case management. Malaria, when uncomplicated, is relatively simple

to diagnose with an RDT and treat with a blister ACT pack. However, severe malaria cases can be more complex to diagnose and always require a significantly higher level of management and nursing care. The majority of severe malaria present first at primary level health facilities (public or private). If the health worker at this level of facility is not equipped or technically able to treat the case, they often refer them to the nearest secondary level care facility. However, because severe cases can deteriorate rapidly, many die before reaching secondary level facilities, especially when this involves travel of several hours or days. In conflict settings such as Yemen, where most health facility services are now compromised, access to effective severe malaria management is severely reduced. Death rates for severe malaria are likely therefore to rise above those of previous years.

As described earlier in this report, malnutrition further complicates the situation, making case management of malaria cases in patients who are severely malnourished very challenging. Each of the clinical conditions aggravates the other, and makes management of both more complex. With gut absorption reduced by up to 50%, management of these more complex cases requires additional reliance upon non-oral route administration of the recommended protocol drugs. At primary level, where severe cases usually first present, it is vital to provide the patient with the first dose of severe malaria therapy prior to their movement onto a referral facility for follow on management. If this is done well, then deterioration and deaths on route can be prevented. At primary level facilities where skills levels of health workers may be very basic, the most effective and feasible way to administer WHO recommended pre-referral treatment is through the use of rectal Artesunate. Capsules of rectal Artesunate are designed as simple suppositories, with simple and safe dosage regimes for different sized patients. Any staff level can be trained to administer rectal capsules and, in situations where transfer to a suitable facility for onward case management may take longer than a day, patient caretakers/family members can be shown how to administer further rectal Artesunate and told when to do this.

IM administration of Artemether or alternatively, use of IV Artesunate, is recommended for the full course of severe case management therapy. Both of these treatment options are WHO approved and similar in effectiveness if administered correctly. However,

IV Artesunate requires a higher level of medical skill to mix and administer than IM Artemether. In facilities where skills levels have been depleted, we recommend the use of IM Artemether in preference to IV Artesunate, to facilitate simpler management of cases.

Estimating Severe Malaria Case Load

The simple rule of thumb is that in malaria high transmission areas, in stable settings, with normal access to health facilities and treatment, approximately 5% of the total malaria cases will present with severe clinical disease. Two contexts change the ratio of uncomplicated : severe cases

1. Epidemics - These only occur amongst communities that have no partial immunity to severe infection, in which case all age groups are at risk of infection and of developing severe disease and dying.
2. Man Made Humanitarian Crises – where health facility access is reduced (i.e. causing delays between falling ill and finding effective diagnosis/treatment), where risks of infection are raised through increased exposure to infective mosquito bites (i.e. displacement and temporary living conditions), and where factors reduce immune status of those infected (multiple types of infections at the same time, malnutrition, etc.).

When these changes of context occur, the risks increase significantly, and severe malaria rates may rise to 10% or more. Rises may be periodic, linked to seasonality, and health facilities may struggle to cope with increased patient case-loads over periods of several months.

In 2016 the total confirmed malaria case load for the four governorates was 70,655. In 2017, the current data indicates that malaria cases may exceed 100,000 and plans should be based on that. Severe malaria cases could therefore reach 10,000 over the 2017 malaria transmission season(s), and there is currently inadequate capacity or commodities to manage these cases in Yemen.

Recommended Activities

Activity/ Procurement	Unit Number	Est. Unit Cost	Estimated Cost
IM artemether (full treatment pack)	5,000	\$35,000	\$35,000
Artesunate rectal capsules	10,000	\$2	\$20,000
IV Artesunate (individual vials of which, 2-5 per person may be required, according to weight, over the treatment period)	10,000	\$2	\$20,000
Syringe/Needle Kits	10,000	\$2	\$20,000
Air freight		20% of total unit costs	\$17,000
Technical Training of Health Workers in malaria diagnosis, treatment of uncomplicated malaria, and pre-referral severe malaria treatment protocol	2,500 (health workers, including public and private sector)	\$85	\$170,000
Technical training of senior health workers for severe malaria full management	1,300	\$85	\$110,500
Specialist technical training organization to manage and deliver the malaria case management capacity building and follow up from June-Dec 2017	1	\$350,000	\$350,000
Total			\$742,500

Recommended Modes of Delivery

Management of malaria cases (uncomplicated and severe) in public and private is under the direct responsibility of the ministry of public health and its health authorities at the governorates and districts levels. In a setting where health service functionality, or access to it, has been so severely disrupted, and malnutrition is so widespread, humanitarian focus

has been heavily on scaling up access to therapy/ care and food for severe and moderate malnutrition cases. With almost 2,929 MoPH health facilities (OTP) supported by the nutritional cluster partners for the delivery of therapeutic care of severely malnourished people, the OTPs placed within the four target governorates are likely to represent the better functioning health facilities and have better trained health staff. The cluster also supports around 1,847 health facilities with Supplementary Feeding Programmes (SFP) to extend food support and basic clinical services to moderately malnourished cases. Many of the suspected severe cases may initially present at these SFPs. The better supported OPTs will be the facilities in which severe malaria cases are most likely to be referred to (or go to directly themselves), whether malnourished or not at the time. Assuming this to be the case, we recommend that:

1. NMCP with the Health and Nutrition cluster leads, on a monthly basis, review and identify health facilities, SFP and OPT severe malaria case-loads in the four governorates.
2. For SFP and OPT receiving effective supply lines through the MoPH/NMCP existing supply chain mechanisms, rectal artesunate should be added into the routine supply line.
3. For those partners who are working in remote SFP and OPT for whom the existing supply chain mechanisms do not reliably reach (we understand that these may represent <20%), contingency stocks should be given directly to, and distributed through cluster partners, to the SFP/HFs which they specifically support, according to the estimated monthly caseloads of suspected severe malaria cases seen and referred onto OPT/HFs.
4. In the same optional manner, according to the local circumstances, IM artemether/ IV Artesunate should be distributed to all OPT/HFs together with other drugs required for the management of related symptoms and complications of severe malaria.

5. The cluster partners should support the NMCP to identify 2000 health workers (public and private sector) for basic malaria case management and severe case pre-referral treatment training.
6. The cluster partners, under the leadership of NMCP, should identify the 800 senior health workers (public and private sector) for severe malaria case management and nursing care training.
7. The health worker trainings will be under the management of MoPH and its related departments (in this case, NMCP). We recommend that provision be made for potential additional support to assist MoPH and the cluster partners of the MoPH, in the arrangements, organization and logistics for such trainings in order that these can be delivered at the scale and in the time frame needed.

BENEFICIARY GROUP 5: Local communities and/or IDPs living in low malaria transmission areas that experience epidemics of malaria. In this case, all age groups will be at risk of malaria (with the exception of IDPs who are over the age of 5yrs and who have originated recently from high malaria transmission areas)

Recommendations: Ensure access to emergency prevention measures and expanded case management services.

Malaria epidemics could occur in any of the governorates assessed, though the people most at risk differ in different circumstances. People who originate from high transmission malaria areas of the region are generally not at risk of malaria epidemics as they will have developed some degree of partial immunity to severe disease. Epidemics within low altitude areas such as most of Al Hudaydah and coastal areas of Hajjah or Taizz are therefore very unlikely to occur amongst local residents. However, IDPs who originate from areas of low/lower transmission can be highly vulnerable to epidemics when displaced into these higher transmission areas.

If adverse conditions, such as temperature, rainfall, malnutrition, lack of access to HFs or movement of infected IDPs into low transmission areas, coincide in higher altitude population centres then these, normally low risk and low transmission, areas may experience malaria epidemics across the resident population and IDPs who originate from similarly low risk areas. In such circumstances, all age groups are at risk of infection and, whilst most of the severe cases will occur amongst children, older children and even some adults may develop severe malaria and die. Those who are already malnourished have an additional vulnerability in this case.

Reinforcing Early Warning

Current surveillance systems are compromised by the partial functionality of health services in the higher altitude population centres in Sa'ada, Hajjah and Taiz, and this makes it very challenging to identify the early indications (unusual case rises) of epidemics, but this is essential to early detection of epidemics and to mounting early responses to mitigate the development of the epidemic and bring it under control. For this reason, we recommend that health cluster and nutrition cluster partners be encouraged to work together with NMCP/MoPH to help facilitate utilization of standardised case definitions and epidemiological reporting. We also recommend that NMCP be reinforced and supported specifically to enhance malaria data collection, collation and analysis to improve the timeliness and utility of the data. WHO country office may be best suited to providing this reinforcement support, as they support the cluster for emergency surveillance already (or possibly a specialised malaria/epidemiology NGO).

Targeted IRS Campaigns

IRS is the WHO recommended first line tool for use in early stages of epidemics. This should only be used for communities living in urban style settings from cities to large villages/camps. It should not be used for dispersed rural households, as it will not provide them with

adequate protection (IRS works on the basis of community, not individual, protection). IRS can be used effectively on almost all wall surface types and is ideal for domestic housing structures, community buildings, and plastic and even canvas tents, etc., that characterise housing types in Yemen.

Delivered in the first weeks of epidemics (ideally, before known epidemic risk factors occur, ie before rainy seasons start), well managed IRS, using either Bendiocarb or Actelic (as Yemen NMCP reports (unpublished) that they have detected insecticide resistance to pyrethroids in some part of the four governorates) will afford people with up to 64% protection from infection for between 3 – 9 months depending upon the insecticide, the wall surface material and quality of application. It can be rolled out relatively rapidly, using local volunteers, who can be trained on site within less than a week, and mobilised under close supervision, to spray their own communities, and it does not depend upon household behaviour, in the way that LLIN's do, to achieve its protective effect for all residents in the community, if over 80% of households in that community are well sprayed. This makes it an ideal epidemic prevention / control tool.

There is no way of estimating where an epidemic may specifically occur, only that the factors that could stimulate one are present or predicted. Altitude, rainfall and malnutrition are key risk indicators for epidemics in Yemen. Equally, it is difficult to estimate how large an evolving epidemic may become if not stopped a controlled, though the scale of the vulnerable people (malnourished being amongst the most vulnerable), and scale of urban settings in risk areas, can give an indication of potential scale, once an epidemic is detected in its early stages. Please see the Table below which demonstrates the vulnerability in terms of malnourished children, and altitude for the three most epidemic risk governorates:

Children on SAM or MAM (2016 totals)	Malaria Epidemic Risk Period - Total Month Span
Taizz 216,000 (14.4%)	0-600m (lowest epidemic risk) coastal areas transmission season in winter (October/November – April) 601-1000m (moderate epidemic risk) transmission in winter and a short summer season (March – May) 1001- 2000m (highest epidemic risk) longer summer season (July – September)
Hajjah 351,000 (23.4%)	0-600m (lowest epidemic risk) coastal areas transmission season in winter (October/November – April) 601-1000m (moderate epidemic risk) transmission in winter and a short summer season (March – May) 1001- 2000m (highest epidemic risk) longer summer season (July – September)
Sa'ada 123,000 (8.2%)	601-1000m (moderate risk) transmission in winter and a short summer season (March – May) 1001- 2000m (low risk) longer summer season (July – September)

In the event of an epidemic in any of these governorates we recommend the immediate roll out of targeted IRS campaigns across the communities in which early epidemic indicators (significant case rises) are detected. Capacity to spray the houses of up to 500,000 people (83,333 households) should be maintained throughout the epidemic risk period (total risk period is March to September). An estimated stock of 33,333 units (estimate coverage of 2.5 houses per unit in 10ltrs spray cans) of Bendiocarb or Actelic should be purchased and stored for 2017 through to September 2018, held in contingency specifically to ensure IRS campaign capacity in the event of epidemics. Assuming that a sprayer can spray 15 houses a day, it will take one sprayer 5,555 spray days. A team of 100 sprayers will take 55 days. In all likelihood there may be multiple smaller epidemics and the resources and teams needed, will vary in size. NMCP have trained a number of spray teams and hold stock of the spray and safety equipment needed, and at least initially, only limited consumables and repairs parts may be needed to maintain that equipment stock. The total capacity allowed for, will ensure a significant response capacity to malaria epidemics at least initially. We recommend (based on experience and previous cost efficacy published reports, that \$2/ per beneficiary (500,000 x \$2) be budgeted as the estimated total operational/HR/logistics delivery costs (not including the cost of insecticide) for either NMCP or an IRS implementing partner NGO.

Targeted Mass Drug Administration

In the event of an epidemic occurring in vulnerable communities which are already suffering with high rates of malnutrition, or amongst other highly vulnerable sectors of the society (including IDPs),

and where rates of severe disease and death are therefore anticipated to be very high, and where the capacity of the health infrastructure to effectively manage the predicted epidemic malaria case-loads is inadequate, we recommend the targeted mass drug administration (MDA).

If CHV networks are established (as per the earlier recommendation) in all recommended areas, then access to effective malaria diagnosis and treatment will greatly improve for those living in the high malaria transmission locations. However, access to these services in the higher altitude population centres is only likely to improve partially, with the recommended commodity support and basic training. It will not be able to cope with the doubling of cases, uncomplicated and severe, that characterise malaria epidemics. Targeted MDA has been shown to dramatically reduce overall prevalence and provide reduced risk of death overall. As a short term, emergency strategy, adjunct to health service access expansion, targeted MDA affords health actors valuable time (a few weeks) to scale up capacity in health services during epidemics, and to roll out IRS in order to stem transmission and reduce the rate of infections.

MDA should be targeted only on those population sectors identified to be most at risk, with the sole is rates that in parallel with targeted IRS campaigns. Whilst all age groups are at risk of malaria during epidemics in higher altitude settings, the most at risk of severe disease and death are almost always children under 15 years of age, people (of all ages) suffering from severe malnutrition, or those suffering from other conditions that compromise their immune status.

We recommend making provision for a maximum of 250,000 treatments (ie 50% of the targeted beneficiary capacity for IRS) for targeted MDAs to be held in reserve and used as part of the epidemic response package.

Yemen has recorded significant plasmodium malaria parasite resistance to amodiaquine monotherapy, and also to ACT with Artesunate + amodiaquine, therefore this normally recommended ACT for seasonal or mass chemo prophylactic use would not be effective in this setting. Therefore, the most suitable option for MDA would be Dihydroartemisinin/piperaquine (DHA/PPQ), a safe and suited, fixed dose combination, not previously used in the country and for which parasites will have no resistance. International suppliers of DHA/PPQ can provide this volume of stock on a rapid basis. Cost of an adult treatment is \$1.30 and child doses are less than \$1.

Recommended Modes of MDA Delivery

1. Targeted MDA mode of delivery will depend upon who was identified as the most at risk group in any epidemic. However, we make the assumption that children under 15 years of old are increasingly vulnerable in these epidemiological settings and therefore modes of delivery that can most easily reach them and deliver MDAs include those traditionally used for MDAs for NTDs. I.e activities that gather together children in an organised manner, preferably accompanied by a responsible carer. These include vaccination campaigns, school and community based deworming campaigns, LLIN distribution campaigns and static service delivery targeting children or mothers (accompanied by children), such as SAM, MAM and PLW.
2. MDA requires little operationally other than drinking water, ACT and standard registration techniques. The first day's dose of ACT is observed therapy, and the carer is instructed how to deliver the second and third day's doses.
3. If IDPs or children are the MDA target, then in order to reach all those targeted, the partners will need to sensitise communities in advance to ensure maximum uptake. Linking MDA with other activities such as IRS can help raise awareness and participation.

We recommend that a budget of \$250,000 be made available and the ACT procured in readiness to ensure that this epidemic response capacity is added into the emergency response choices alongside IRS. Cost of delivery can be minimal or zero if delivered through existing Health and Nutrition Cluster activities that are already designed to reach the same target group.

Additional Recommendations

1. As stated above, though IDPs represent the one of the most vulnerable groups in conflict zones, they should be seen and treated as part of the host communities they live in, even if they are living in (makeshift) settlements. Delivery of services to specific target groups only, often if not always leads to social conflict with all due consequences, as the communities as a whole are in need. Providing malaria treatment and prevention services to communities at large will avoid conflict and ultimately include all children under five years of age and pregnant women.
2. In the current (political) situation in Yemen, where the north and the south exist in a violent and defragmenting symbiosis, it is strongly recommended to propose and start malaria control activities simultaneously in the north and south, in accordance with recommendations following the assessment.
3. In order to achieve the highest impact on the level of malaria control in Yemen in relation to the limited financial resources and a noted time pressure after delays in GF funding, it seems paramount that a very targeted approach is being followed. Most affected districts in all concerned governorates have to be identified in light of the above-mentioned recommendations. Financial resources could be linked to a 'work in progress', meaning that, because it is impossible to have a complete and full assessment of the malaria burden in Yemen and hence an immediate comprehensive program lined up, activities should start in a few districts where the malaria burden and risk has been clearly assessed. Thus, the available budget will be utilized as soon as possible to cover immediate and clear needs whilst allowing for further field assessments to

further structure consecutive programs on malaria control. These assessments are paramount to justify maximum impact of malaria control activities in a highly volatile and difficult context.

4. IEC is very important in ensuring uptake and correct usage of prevention and case management services. Technical agencies supporting the delivery of the IOM/GF 2017 programme will need to design a standardised package of messages that inform and encourage targeted beneficiaries to accept, use correctly and maintain LLIN (and IRS where this has been used to date). As retention and usage of LLIN has been quite poor historically in Yemen, the chances of poor usage of additional LLIN now and in the future, is high. IEC, alongside the more strategic approach of distributing LLIN with priority into low altitude/high transmission/high nuisance insect areas, will help improve usage. IEC to encourage early diagnosis, treatment seeking when individuals fall sick and informing people of where they can access services will also be important. Messages may need to be combined together with nutrition messages to raise awareness of the added risks of malnutrition + malaria and to encourage appropriate healthcare seeking at the higher-level health facilities. Specific consideration may be required for messaging concerning rectal Artesunate to ensure acceptance amongst carers and children. Wherever possible, IEC message design should include information on other diseases, such as leishmaniasis, and corresponding synergistic protective effects of prevention methods, such as LLIN or a house that has been sprayed. This awareness can contribute to improved usage of LLIN in areas where Leishmaniasis is endemic. Equally, dengue awareness and the means by which *Aedes* mosquitoes breed around homes and communities and transmit the disease is important. This can be done in conjunction with messages on how to clean and remove potential *Aedes* breeding sites from around the home/garden/streets, to reduce infection

risks, and can be simple and important to integrate. Finally, as there will be many IEC packages being delivered by multiple organizations, wherever possible opportunities to combine delivery or standardised messages (radio, TV, door to door, schools, mosques, etc.) should be explored and piloted with cluster partners.

5. LLIN are relied upon currently as one of the main malaria prevention tools in Yemen and these also assist in prevention of leishmaniasis. However, NMCP have reported pyrethroid insecticide resistance at concerning levels in coastal areas and are concerned that this may reduce the protective efficacy of standard LLINs. We recommend that LLIN procurement for future LLIN shipments be of PBO + pyrethroid based LLIN, as these are recommended by WHO and are likely to perform better than standard LLINs in this setting.

Limitations Notes

1. Please note it is beyond the scope of this assessment TOR to provide more than outline budget indications for the recommended activities needed to improve malaria control in the different epidemiological zones of the priority governorates. MENTOR would be happy to work with country partners on the ground to design detailed delivery strategies and comprehensive budgets for the realization of these recommendations, and to assist country partners to achieve the delivery of these activities in the flexible manner that will be required, and in the highly collaborative and cross cluster manner that will be needed.
2. This assessment has been finalized on the basis of a first impression of the realities on the ground. Access to the field has proven to be a challenge, mainly because of the very tight security protocols. Further targeted assessments are needed to be able to guarantee a certain quality of a malaria control program that will remain a work in progress, as stated above.

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