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Strengthening malaria surveillance for data-driven decision making in Mozambique

June 2019 to December 2022

Established in 2003, Malaria Consortium is one of the world's leading non-profit organisations specialising in the prevention, control and treatment of malaria and other communicable diseases among vulnerable populations. Our mission is to save lives and improve health in Africa and Asia through evidence-based programmes that combat targeted diseases and promote universal health coverage.

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Abbreviations and acronyms

CHAI	Clinton Health Access Initiative
CISM	Centro de Investigação em Saúde de Manhiça Manhiça
CoP	Chief of Party
D2A	data to action
DA	data accuracy
DQ	data quality
DQA	data quality assessment
DU	data use
EWS	early warning system
HF	health facility
iMISS	integrated malaria information storage system
IRS	indoor residual spray
KPI	key performance indicator
M&E	monitoring and evaluation
MDA	mass drug administration
MoH	Ministry of Health
NMCP	National Malaria Control Programme
SBCC	social and behaviour change communication
SIS-MA	Sistema de Informação de Saúde para Monitoria e Avaliação
SM&E	surveillance, monitoring and evaluation
SOP	standard operating procedure
ToR	terms of reference
TWG	technical working group
USD	United States dollars

Overview

This document summarises the results of three-and-a-half years of programme implementation. It highlights the overall findings, learnings and recommendations for scaling up malaria surveillance activities in Mozambique.

Remarkable progress in the implementation of data quality assessment activities was noted throughout the programme's implementation. Overall, recurrent data quality assessment was found to improve data quality over time. This enabled improved informed decision-making. In addition, the accuracy of the data at the health facility and the district level improved considerably throughout the project period. In total, 1,458 malaria-focused data quality assessment visits were conducted in 278 health facilities across 37 districts. This resulted in nearly 2,300 months of data being assessed.

The rollout of the integrated malaria information storage system (iMISS) and other tailored data quality assessment strategies developed during the programme's implementation helped to overcome challenges to ensuring good data quality. However, the lack of operational, logistical and financial resources at the local level to ensure these activities are recurrently implemented remains a challenge. This challenge can only be overcome with the integration of activities as proposed in this project's social and behaviour change communication strategy.

During this project, data reporting tool stockouts were significantly reduced and the timeliness of supplies arriving at the health facility level improved. Following an initial emergency stockout, which was addressed by the project through the massive distribution of registration books and reporting forms, the Ministry of Health started to ensure continuous stocking of these tools, became engaged in recurrent stock analysis, and increased their ownership of production and distribution.

The iMISS was successfully rolled out, becoming functional across all districts by the end of the project, as well as in 91 percent of health facility in districts that were classified as 'intensive' according to the project. The development and rollout of the iMISS at all levels was a central activity in this programme and more than 1,600 Ministry of Health staff were trained to use the iMISS. This initial training played an important role in helping to collect feedback and continue to improve the system. In addition to training, the iMISS field supervisions played a crucial role in addressing uptake concerns, contributing to the noticeable benefits in the quality of reported data over the course of the project.

By the end of the project, data-driven decision-making and planning became frequent in many districts, with data-driven meetings being conducted regularly. As the iMISS became available, these meetings were used to encourage discussions that were based on, and guided by, the dashboards and tools available. This was also an opportunity to raise actions that emerged from the data. These actions were responded to and marked as solved in subsequent meetings.

During this project, the *Centro de Investigação em Saúde de Manhiça* (otherwise known as the Manhiça Health Research Centre) REACT surveillance project also started in Magude and Matutuíne. This component sought to gather evidence to inform the development of an operationally feasible model for conducting case/foci investigations and refine surveillance strategies for low transmission contexts. The operational research results, which include feasibility, cost-effectiveness and acceptability analysis, have been compiled and will go on to be disseminated internationally and used to inform the definition of local surveillance approaches.

An early warning system was also developed and integrated into the iMISS as part of the project. This system integrates several epidemiological and environmental covariates and aims to anticipate

outbreaks, prompting actors to decide and act more rapidly. The early warning system was integrated into the iMISS in year 3.

Improved and sustained capacity for surveillance at all levels of the health system was facilitated by the project through health staff training all districts in Mozambique. These trainings included data quality, data use and data to action. Recurrent technical support was provided throughout the programme at central, provincial and district levels. This support focused on developing local capacity rooted in the development of tailored strategies and tools. At the provincial and the district level, Malaria Consortium staff regularly meet with local Ministry of Health staff to encourage the effective use of data for decision-making.

Throughout the project, the National Malaria Control Programme has made considerable progress towards the achievement of the 2017–2022 National Strategic Plan objective to improve surveillance, by putting in place a surveillance system and establishing the iMISS. Through a range of different approaches and interventions, it was possible to improve the quality of data in the country and improve the percentage of health facilities reporting data on time (from 66 percent to 98 percent). The improved system will better equip malaria staff at national, provincial, district and community levels to improve data quality and use to monitor indicators. It will also improve the ability to plan and implement information-based actions and responses in tackling malaria.

1 Background

The project Strengthening Malaria Surveillance for Data-driven Decision-making in Mozambique, was funded by the Bill & Melinda Gates Foundation. This was a three-and-a-half-year programme (three years, followed by a six-month extension) that started in June 2019 and was completed in December 2022. It has been implemented by Malaria Consortium in close collaboration with the Mozambique National Malaria Control Programme (NMCP), the *Centro de Investigação em Saúde de Manhiça Manhiça* (CISM — otherwise known as Manhiça Health Research Centre) and the Clinton Health Access Initiative (CHAI). The project aimed to strengthen malaria surveillance, improve data quality, and increase the use of data for strategic and operational decision-making in Mozambique. The project was designed to address some of the major bottlenecks for effective routine malaria surveillance in Mozambique that were identified in a 2018 surveillance assessment.[i] These bottlenecks included:

- poor malaria data quality (DQ) and data use (DU)
- lack of an integrated malaria information storage system (iMISS)
- weak national capacity to implement surveillance activities
- insufficient essential stocks (e.g., health supplies and recording tools)
- lack of context-specific guidelines and policies to operationalise malaria surveillance activities
- coordination mechanisms challenged by the large number of investments and initiatives in the malaria space.

To address these issues, the programme aimed to improve the malaria surveillance system in Mozambique by i) improving data quality and use for decision-making at all levels of the system; ii)

[i] Malaria Consortium. Malaria surveillance system performance in Mozambique: a comprehensive assessment. London: Malaria Consortium; 2018. Available from: https://www.malariaconsortium.org/resources/publications/1169/malaria-surveillance-system-performance-in-mozambique-a-comprehensive-assessment.

expanding the access and use of essential malaria-related data; iii) improving malaria surveillance capacity at all levels; and iv) evaluating intervention packages and disseminating evidence gathered throughout the project (Figure 01).

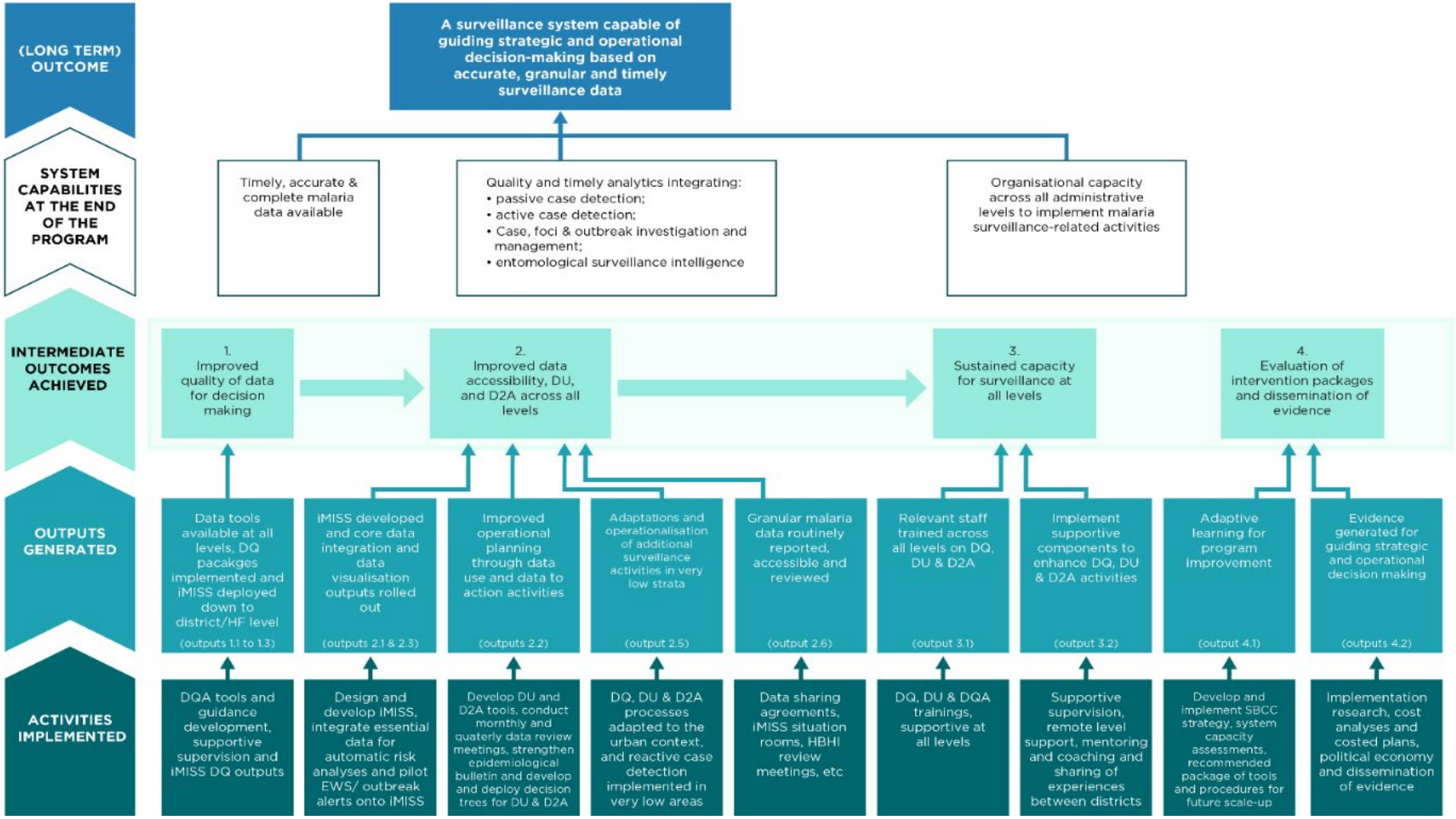


Figure 01: Project Theory of Change detailing the relationship between activities and outputs generated, the outcomes achieved and the expected long-term outcomes

The programme was designed to implement three different packages of interventions at different levels of intensity (Figure 02):

- The Standard (Std) package consisted of basic support to the NMCP standard activities implemented across all districts, while integrating some of the tools developed through the implementation of the other packages, including the rollout of the iMISS at district level
- The Standard plus (Std+) package was implemented in nine districts and supported the implementation of additional activities (supportive supervision, data quality assessment [DQA] visits) beyond what was done regularly
- The Intensive (Int) package was implemented in seven districts across the country and trialled more aggressive strategies in addition to activities for the Standard package and Standard plus package, such as iMISS rollout at the health facility (HF) to strengthen malaria surveillance.

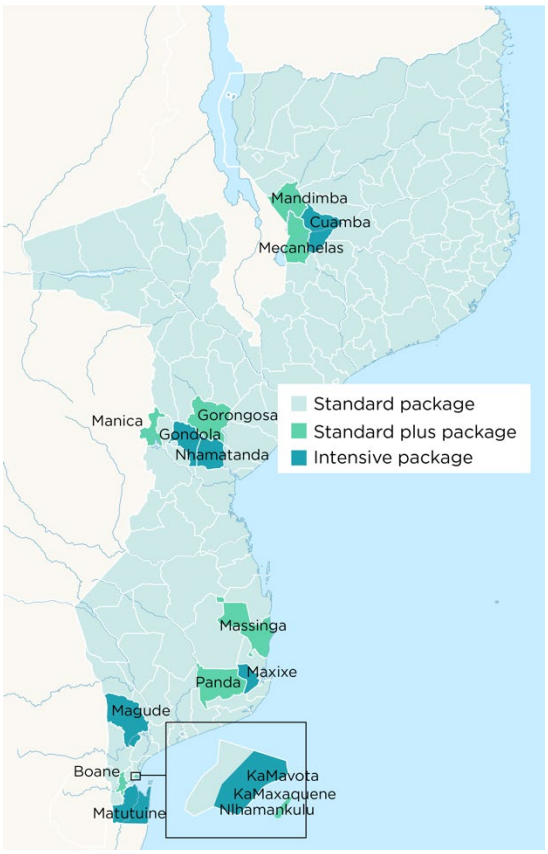


Figure 02: Geographical implementation of different packages

This report summarises the major achievements of this programme in creating and sustaining a high-quality malaria surveillance-oriented culture in Mozambique. It describes major outcomes, as well as the tools and the NMCP processes developed and implemented at all levels.

This report also summarises the challenges and lessons learnt throughout the project's implementation and provides key recommendations to the NMCP and partners to sustain the improvements made to the malaria surveillance system in Mozambique.

2 Project management and partner coordination

The implementation of this ambitious and innovative project required significant partner coordination to ensure all project components were implemented on time and in a logical manner. Regular partner coordination meetings were essential to harmonise implementation time frames and ensure objectives were clear and aligned between all partners involved. Regular engagement with the NMCP and the relevant departments was key to ensuring that tools and approaches were discussed and agreed before development, pilot and rollout. These coordination mechanisms ensured a timely and sequential discussion, development, implementation and assessment process. This guaranteed the rollout of field activities and tools that were tailored to the Mozambican context.

Management and coordination of partners took place through recurrent calls and progress reports, in which challenges were shared and adjustments were proposed. Regular feedback, discussion and

sharing were important to ensure harmonised approaches to activities being implemented in a sequential manner, such as training and supervision. Similarly, these coordination mechanisms contributed to improved efficiency in the use of funds by integrating some components into existing, planned activities by donors. An example was the integration of DQA and DU training components into the planned training funded by the Global Fund to Fight AIDS, Tuberculosis and Malaria.

Malaria Consortium surveillance project operations were based on a regional structure (north, central and south), with regional coordinators that oversaw provincial teams. At the central level (Maputo), the Malaria Consortium team supported the management of day-to-day programme operations of all the regions and provinces through the Senior Management Team. This team was composed of the Chief of Party (CoP), Country Finance Manager, Surveillance Specialist, Epidemiologist, and Knowledge and Communications Specialist. This team was also directly supported by Malaria Consortium's Head of Surveillance, Monitoring and Evaluation (SM&E) and by other specialist staff that provided dedicated support to specific needs.

Regular engagement with the NMCP and partners occurred throughout the project. This enabled the identification of technical gaps raised by the NMCP. Malaria Consortium responded to these *ad hoc* requests, such as providing support to finalise, harmonise and review integrated supervision tools, training manuals for DQA tools, and the NMCP SM&E manual, as well as the review of the NMCP monitoring and evaluation (M&E) plan. Support to develop new approaches and tools was central to programmatic management. This included the development of standard operating procedures (SOPs) for outbreak investigations, self DQA and death audits. Discussions and regular engagement with SM&E technical working groups (TWGs) were also key to ensuring ongoing discussion on surveillance tools and strategies. As a key partner, Malaria Consortium significantly contributed to fostering discussions around surveillance results and the products developed during the programme period.

Several management and coordination challenges had to be overcome during the project. The initial start-up phase was challenging due to ongoing recruitments and the set-up of a memorandum of understanding with the provincial health departments. With the recruitment of a CoP, the project was able to address these challenges. During the remaining years of the programme, project management and partner coordination became a collaborative and smooth process. The COVID-19 pandemic had a significant impact on the implementation of activities. The pandemic imposed changes in the operating model, as it restricted field activities and in-person meetings. Consequently, this impacted on the quality of discussions. COVID-19 restrictions also affected training, and partner and field meetings (such as data discussion meetings). Online meetings became the standard operating model but, as recognised by most of the participants, the level of engagement was less than that achieved during face-to-face meetings.

3 Results achieved through activity implementation

3.1 Outcome 1.0: Improved availability of data quality for decision-making

Table 01: Progress ofKPI #1, #3 & #4 over time per package of implementation

KPI	Baseline[1,2]	Target	Year 1 [1]	Year 2	Final
KPI #1: % of HF reporting data on time	Std: 66%[2]; 92%[1]	95%	92%[1]	96%[1]	97%[1]
	Std+: 66%[2]; 93%[1]	100%	99%[1]	99%[1]	99%[1]
	Int: 66%[2]; 97%[1]	100%	99%[1]	99%[1]	99%[1]
KPI #3: % of HF reporting accurate data	Std: 33%[2]	90%	40%[3]	44%[3]	92%[4]
	Std+: 33%[2]	90%	57%[3]	61%[3]	86%[4]
	Int: 33%[2]	95%	35%[3]	68%[3]	84%[4]
KPI #4: % of districts reporting accurate data	Std: 58%[2]	90%	82%[3]	100%[3]	88% [4]
	Std+: 58%[2]	100%	50%[3]	91%[3]	99%[4]
	Int: 58%[2]	100%	57%[3]	88%[3]	97%[4]

off track for target | on track for target | target reached | N/A

[1] *Sistema de Informação de Saúde para Monitoria e Avaliação* (SIS-MA — otherwise known as the Integrated Health System for Monitoring and Evaluation) data
[2] 2018 surveillance assessment data[ii]
[3] DQA data collected through dedicated DQA database managed by Malaria Consortium
[4] iMISS data collected in October 2022
Note: KPI #2 is not reported as it does not apply to the existing data flows of the surveillance system. There are no district reports submitted to the system and, for that reason, it is not possible to assess district timeliness of report submission

There were considerable improvements in the data accuracy reported from both districts and HFs by the end of the project (Table 01). Timeliness, which was already high at baseline, remained as such and improved in Standard districts (KPI #1). Accuracy of reporting from HFs (KPI #3) saw large improvements from baseline levels of just 33 percent across districts in all packages. Accuracy of reporting from HFs rose to 84 percent and 86 percent in Standard plus and Intensive districts, respectively, and to 92 percent in Standard districts. Similar gains were seen in districts' accuracy of reporting, which improved from baseline levels of just 58 percent to 88 percent in Standard districts and almost 100 percent in Standard plus and Intensive districts (KPI #4). These improvements were a core component of the project and were achieved by improving tool and material availability, implementing data quality packages, and deploying the iMISS down to the district and HF levels (in Intensive districts).

The timeliness of HF reporting (KPI #1) showed consistently good performance over the course of the project, reflecting the prior existence of basic processes for data reporting. However, gaps in timeliness were noted in Cabo Delgado province due to security issues. To respond to such

[ii] Malaria Consortium. Malaria surveillance system performance in Mozambique: a comprehensive assessment. London: Malaria Consortium; 2018. Available from: https://www.malariaconsortium.org/resources/publications/1169/malaria-surveillance-system-performance-in-mozambique-a-comprehensive-assessment.

challenges moving forward, alternative reporting mechanisms should be explored to ensure minimal impact on the surveillance system's ability to function normally.

Additionally, discrepancies in timeliness were found between the *Sistema de Informação de Saúde para Monitoria e Avaliação* (SIS-MA — otherwise known as the Integrated Health System for Monitoring and Evaluation) and the reporting dates communicated from HFs during DQA visits. This was attributed to a difference in the way reporting dates were recorded. HFs reported the date of submission as the day the report was sent, while SIS-MA reported it as the day that data were submitted at the district level. To account for this difference, 'timeliness' was considered to be the district-level date of submission, as this was the date that data became available in SIS-MA and the iMISS.

The accuracy of data from HFs (KPI #3) was a challenge across all packages; however, considerable improvements have been achieved. In total, this programme supported 1,458 DQA visits to HFs across all packages of implementation. The DQA visits at HFs were used to assess the consistency and accuracy of data by comparing monthly reports with HF outpatient consultation books (Success Story 01). This multifaceted exercise was also seen as both a training exercise and coaching visit to improve the quality of reporting.

Success Story 01: Data quality improvements in Inhambane province

Remarkable success in the implementation of DQA was observed in Inhambane province. Inhambane reported zero discrepancies between the monthly report data and the data reported into SIS-MA (Figure 04). This is the result of continued DQA activity implementation over time.

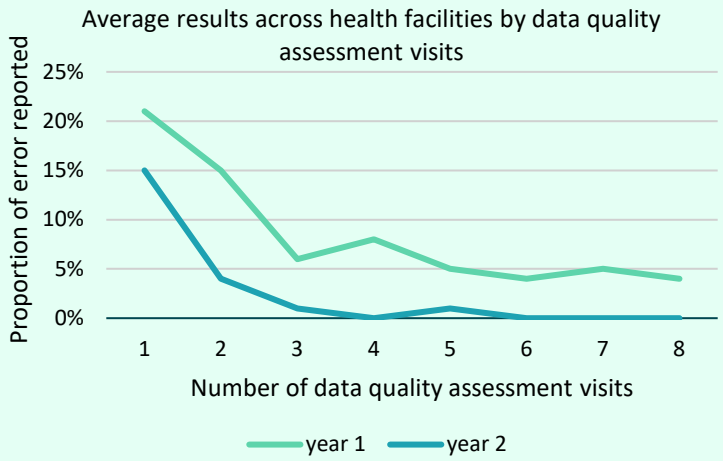
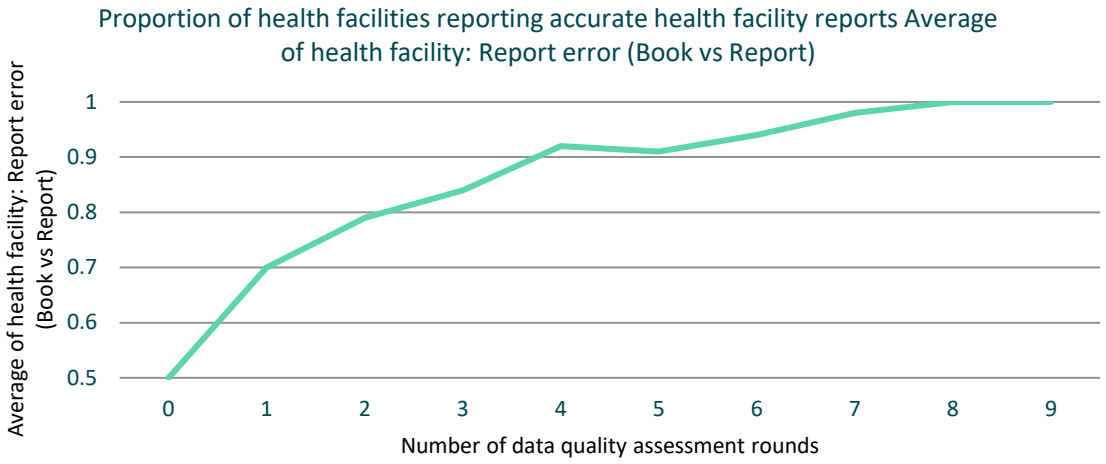


Figure 03: Evolution of data quality in Inhambane province throughout the time of programme implementation. Green = percentage of error at health facility when comparing consultation books vs reports; blue = percentage of error comparing paper report vs SIS-MA

Data quality assessment being conducted in *Centro Saúde Inhaloi-Massinga*, Inhambane

The regular and sustained implementation of DQA visits in Standard plus and Intensive package districts provided evidence that the quality of data improves with an increased frequency of visits. A refined analysis of the data obtained in Intensive package districts showed that only 46 percent of HFs had an accuracy score of 'good' (deviation less than 10 percent when comparing outpatient books and monthly report data) in the first visit, but by the fifth round of visits, this proportion increased to over 90 percent (Figure 04).



Number of visits	Proportion of health facilities with accurate* monthly reports compared to register books	Proportion of health facilities with inaccurate reports that change to accurate* by the next follow-up visit**
Baseline	52.0% (92/177)	64.7% (55/85)
1 follow-up visit	69.5% (123/177)	59.3% (32/54)
2 follow-up visits	78.7% (122/155)	57.6% (19/33)
3–7 follow-up visits	89.3% (283/317)	67.7% (129/206)

*Accurate = Deviation between the number of confirmed cases reported in outpatient books and monthly reports less than ten percent
** Including missing

Figure 04: Analysis of the variation found in the proportion of health facilities reporting accurate reports and data per data quality assessment visits conducted in Standard plus and Intensive package districts

Despite the observation that accuracy increased with the number of DQA visits conducted, data accuracy was also seen to improve among HFs in Standard districts where fewer DQA visits were conducted. In the final year of the project, over 700 DQA visits were conducted in Standard plus and Intensive districts, compared to just 80 across Standard package districts. Despite this, the reporting accuracy increased in Standard districts to 92 percent (KPI #3). The lower performance among HFs in Standard plus and Intensive districts compared to Standard districts can be attributed to HFs' reporting in Maputo province. Maputo province presented a challenge throughout the project, and the reporting accuracy from HFs in this province was consistently around 50 percent. Comparatively, reporting from other supported districts in the Standard plus and Intensive packages was around 90 percent. It was perceived that as malaria transmission has decreased, awareness of the importance of data reporting has also reduced. This represents the key learning that in low transmission settings, a focus on accurate reporting is crucial and the messaging for health workers needs to be strengthened and supported with continuous training and supervision.

The percentage of districts reporting accurate data (KPI #4) also increased consistently over the project period and across all implementation packages. This can be linked to the increased awareness around the importance of data quality and availability. This awareness was particularly

important during district- and provincial-level discussions, which were used to identify problems with the data and helped to support improved reporting accuracy.

One key challenge that led to accuracy issues was typing mistakes. These were usually caused by new staff members entering data into the system. This highlighted the importance of ensuring that clear guidance for data entry is available in the future and that training and supervision are provided frequently for new staff members in charge of data entry at district level.

A limitation for the data analysis in both KPI #3 and KPI #4 was the change in the data collection method used to compile the indicators. DQA data was not available in the iMISS during the first two years of the project. Instead, data were gathered through a system developed and implemented in Malaria Consortium-supported districts. With the integration of DQA data into iMISS during year 3, it became possible to analyse data from all districts and HFs conducting and reporting DQA. This enabled better visualisation and understanding of malaria data quality across Mozambique. However, as a result of this change, DQA results in Standard plus and Intensive package districts reference the majority of HFs and districts visited, while the results for the Standard package represent a small fraction of the total HFs and districts.

Removing the over- and under-reporting of malaria cases has improved the accuracy of the data coming from HFs and helped to build an accurate understanding of the malaria epidemiology in Mozambique. This will, in turn, aid the supply and allocation of resources to control malaria. We expect that with NMCP support and advocacy, these activities will be scaled up across the country, promoting the gradual improvement of data quality for decision-making.

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Takeaways from DQA implementation

- DQA data in the iMISS are essential to have a clear view of the data quality across the country
- Frequent DQA exercises are essential to improve the accuracy of data
- New approaches can be adopted to reduce the financial and operational burden of DQA field visits (self DQA)
- Use of DQA indicators in data-driven discussions improves data quality and supports a better understanding of epidemiological trends.

DQA recommendations

- Ensure DQA information is available in the iMISS and indicators are regularly used to monitor the quality of data
- Foster DQA exercises across the country using field, self or remote DQA guidance and implementation
- Stimulate, at all levels, the regular triangulation of epidemiological data with DQA data to ascertain the quality of analysis done and account for potential quality bias.

3.1.1 Output 1.1: Recording and reporting tools, guidelines, standard operating procedures and training materials available across all levels for data quality

Table 02: Progress of KPI #5 and #6 over time per package of implementation

KPI	Baseline	Target	Year 1	Year 2	Final
KPI #5: % of HFs without any type of registry stockout (report forms)	Std: 25%[1]	90%	N/A	N/A	N/A
	Std+: 25%[1]	95%	100% [2]	97%	92%
	Int: 25%[1]	100%	100% [2]	99%	99%
KPI #6: % of HFs without register book stockout (outpatient register book only)	Std: 25%[1*]	90%	N/A	N/A	N/A
	Std+: 25%[1*]	95%	47% [2, 3]	98%	92%
	Int: 25%[1*]	100%	43% [2, 4]	97%	98%

off track for target | on track for target | target reached | N/A

[1] 2018 surveillance assessment data[iii]
[2] Data collected through DQA visits conducted by Malaria Consortium after the distribution of tools (Q1 and Q2 2020)
[3] Data collected before the distribution of registration books
[4] Part of the data was collected before distribution of registration books
* No specific data exclusively on the availability of outpatient register books was collected. As baseline, the same proportion of stockouts verified for all registration forms noted in the 2018 surveillance assessment was assumed

The availability of monthly report forms and outpatient register books in Standard plus and Intensive package districts improved over the course of the project, from an estimated 25 percent at baseline to 92 percent in Standard plus districts, and just under 100 percent in Intensive package districts. This is represented by the percentage of HFs that did not experience stockouts of these tools (KPI #5 and #6) (Table 02). It was not possible to monitor the stockouts of these tools in Standard districts as these indicators were collected during DQA visits, which were not carried out regularly in Standard districts.

By utilising existing distribution supply chain systems and providing support to ensure that tools could reach the provincial level, this programme supported the production and distribution of more than 18,000 registration tools (e.g. outpatient registration tools, monthly reports and filing cabinets). The programme also responded to urgent gaps including the procurement and distribution of nearly 7,000 outpatient registry books and 600 filing cabinets over years 2 and 3.

[iii] Malaria Consortium. Malaria surveillance system performance in Mozambique: a comprehensive assessment. London: Malaria Consortium; 2018. Available from: https://www.malariaconsortium.org/resources/publications/1169/malaria-surveillance-system-performance-in-mozambique-a-comprehensive-assessment.

In addition to improving the supply of existing tools, the following novel guidance and tools were developed and implemented over the course of the project:

Delivery of registration tools at Messica Health Facility

- Data quality tools and manuals, followed by support to DQA provincial training and the implementation of DQA
- A self-DQA manual to support the continued rollout of DQA following programme closure in areas where no funds are available to run DQA dedicated supervision
- A dedicated DQA database to enable data analysis and guide actions focused on improving data quality. The database was designed and used in years 1 and 2 and then transferred into the iMISS for year 3. Insights from this database were key in informing the iMISS dashboard visualisation tools
- A terms of reference (ToR) for district data quality review meetings providing a set of essential questions to ask when revising data quality indicators.

Reducing reporting tool stockouts was a key priority for the programme, as the low number of data collection tools available in HFs in Mozambique was identified as one of the main problems in the 2018 surveillance assessment, impacting the quality and availability of data.[iv]

While the project filled Ministry of Health (MoH) gaps, during the course of year 3, there was greater adoption of production and distribution by the MoH. This adoption will ensure ongoing production and distribution down to the provincial level, improving programme sustainability.

Increasing the understanding of the importance of having a constant supply of reporting tools was also essential for this output and the overall outcome of improved availability of quality data (Success Story 02). District-level meetings in Standard plus and Intensive package districts were used to identify gaps and actions to address tool supply at HF level. This approach allowed gaps to be promptly recognised and responded to. During these meetings, it was found that most of the gaps in tool availability were caused by delays in the requests from the HF to the district level. Staff turnover was also associated with these delays due to the time needed to become familiar with the processes in place.

[iv] Malaria Consortium. Malaria surveillance system performance in Mozambique: a comprehensive assessment. London: Malaria Consortium; 2018. Available from: https://www.malariaconsortium.org/resources/publications/1169/malaria-surveillance-system-performance-in-mozambique-a-comprehensive-assessment.

Success Story 02: The impact of registration tool distribution.

The distribution of registration tools was key to improving data quality. In Manica and Gondola districts, Malaria Consortium talked with Dr Santana Missage and Dr Paulo Seda, who referred to the improvements noted after the distribution of tools. Prior to this, case registration was done in notebooks. These took more time to fill out and the manual process was more prone to error. The distribution of filing cabinets also helped to ensure data were not lost as it could be properly archived. A video was created to highlight this success story.[v]

3.1.2 Output 1.2: Data quality packages implemented

Table 03: Progress of KPIs #7–10 over time per package of implementation

KPI	Baseline	Target	Year 1	Year 2	Final
KPI #7: % of districts receiving DQA visits at least once a year	Std: N/A	70%	8%	5%	89%
	Std+: N/A	100%	66%	100%	100%
	Int: N/A	100%	100%	100%	100%
KPI #8: % of HFs receiving DQA visits at least once a year	Std: 55%[1]	60%	2%	3%	7%
	Std+: 55%[1,2]	100%	68%	89%	98%
	Int: 55%[1,2]	100%	91%	96%	99%
KPI #9: % of reported DQA issues identified in district meetings that were addressed	Std: N/A	30%	N/A	N/A	N/A
	Std+: N/A	100%	26%	66%	75%
	Int: N/A	100%	74%	65%	81%
KPI #10: % of HFs improving data quality score over a one-year period	Int: N/A	60%	N/A	76%	87%

off track for target | on track for target | target reached | N/A

[1] 2018 surveillance assessment data[vi]
[2] Averaged for all districts as no specific package information was collected

There were improvements in the data quality packages implemented across Standard plus and Intensive package districts by the end of the project. In Intensive packages, the percentage of districts receiving DQA visits at least once a year remained at 100 percent throughout the course of the project (KPI #7); similarly, the percentage of HFs receiving DQA visits at least once a year remained consistently high (KPI #8) (Table 03). Intensive package HFs also their improved data quality scores (number of HFs improving the data accuracy score from one DQA to another). Over a

[v] Malaria Consortium. Strengthening surveillance for data-driven decision making in Mozambique: Registration books [video]. London: Malaria Consortium; 2023. Available from: https://www.youtube.com/watch?v=-kNfWxuPipI.
[vi] Malaria Consortium. Malaria surveillance system performance in Mozambique: a comprehensive assessment. London: Malaria Consortium; 2018. Available from: https://www.malariaconsortium.org/resources/publications/1169/malaria-surveillance-system-performance-in-mozambique-a-comprehensive-assessment.

one-year period 87 percent of HFs had an improved score by year 3 (KPI #10). In Standard plus packages, the percentage of districts and HFs receiving at least one DQA visit per year increased from baselines of 66 percent and 68 percent to 100 percent and 98 percent, respectively (KPI #7 and #8). By the end of the project, the percentage of Standard package districts receiving DQA visits at least once a year had also increased to 89 percent, from only eight percent in year 1 (KPI #7). The same improvement was not seen for Standard package HFs, with only seven percent of HFs receiving at least one visit by the end of the project (KPI #8). By the end of the project, 75 percent and 81 percent of DQA issues identified in the district meetings in Standard plus and Intensive package districts, respectively, had been addressed, falling short of the target of 100 percent.

The improvement in the proportion of districts receiving at least one DQA visit per year (KPI #7) was a particular achievement in Standard package districts where DQA relied mostly on MoH resource mobilisation, and these activities were frequently deprioritised. The remaining gaps in DQAs at district level were mainly justified by the limited accessibility in some districts in the Cabo Delgado province due to insecurity. Scaling up DQA activities in Standard package districts was a major challenge, particularly in HFs (KPI #8). The challenge in reaching HFs highlights the need to ensure adequate resources for DQA visits in the future, and the need to find alternative methods to ensure HFs conduct routine DQA exercises if resources are limited. Integration of DQA alongside other HF supervision may be the best strategy to ensure these exercises are done across the country moving forward. However, this proposed strategy may become cumbersome and take away the attention to detail required for a good DQA exercise. Alternative approaches including self DQA were piloted throughout the programme to ensure implementation in districts with low resources. Such approaches may serve as solutions to overcome the logistical and financial challenges associated with running these activities without external support.

DQA in Ntembo Health Centre, Mandimba district, with health facility staff and a community health worker

While improvements were seen over the course of the project, the targets for the proportion of reported DQA issues identified in district meetings that were addressed (KPI #9) in Standard and Intensive packages were not met during this project. Any issue raised during a district meeting was logged for follow-up, and some issues required resources that were unavailable at the district level, or which were not made available through this project. This included responding to staff turnover or investments in HF infrastructure. Despite falling short of the project targets for KPI #9, it should be highlighted that significant improvements were still made, with more than three-quarters (192 out of 244) of the issues raised in district meetings responded to in year 3, compared to less than a quarter in year 1. This shows the gradual uptake of a data-driven culture.

Field experience also shows that the combination of DQA action, data discussion meetings and tool availability increased the demand and use of quality data in line with outcome 1. The implementation of data discussion meetings helped to refine indicators to use in the DQA dashboards by incorporating feedback from district managers. Likewise, the identification of data-

related issues during meetings improved as managers became more familiar with dashboards and how to identify critical issues through questioning.

However, this change in mindset may not be transferrable to the whole country as activities were not implemented with similar levels of support in Standard package districts. It is imperative that the NMCP guarantees that these data culture approaches are scaled up to all districts and HFs in the country. Hopefully, the existence of DQA tools and metrics in the iMISS will help to foster that interest in data quality and use, as has been seen through the gradual uptake of DQA activities across non-supported districts in year 3.

3.1.3 Output 1.3: Integrated malaria information storage system deployed down to the district level

Table 04: Progress of KPI #11 overtime per package of implementation

KPI	Baseline	Target	Year 1	Year 2	Final
KPI #11: % of districts reporting monthly data through the iMISS	Std: N/A	85%	N/A	97%	100%
	Std+: N/A	100%	N/A	100%	100%
	Int: N/A	100%	N/A	100%	100%

off track for target | on track for target | target reached | N/A

The iMISS implementation (which began in February 2021) played an important role in improving the DQ and DU. By the end of the project, 100 percent of districts were reporting monthly data through the iMISS in all three implementation packages (KPI #11) (Table 04). This surpassed the target of 85 percent set for Standard package districts, and the iMISS is now widely available and in use across the country. In total, 1,650 individual users were trained across all levels, and tablets were procured and distributed across provincial and district levels over the course of the project.

The rollout of the iMISS allowed for the use of dashboards to guide data discussion meetings in year 3. It was also useful to consult the iMISS to help identify data-related problems. Having data in a single platform enabled further discussions at district –level, allowing for the comparison and triangulation of data quality indicators with epidemiological indicators. This made it possible to cross-check if trends were biased by data quality (when DQA results show high discrepancies between the reports and sources of information).

In year 3, the iMISS-focused supervision was conducted across nine provinces (and 89 districts), targeting 318 health workers. Supervision focused on data entry processes for supervision forms, synchronisation issues, and dashboard navigation and manipulation to improve understanding of HF performance. While the focus of this supervision was on troubleshooting, it also served to collect feedback from users on how to improve dashboards and overall function of the iMISS. The supervision also helped scale up the use of the iMISS, particularly amongst users with less capacity and those not using the iMISS regularly.

3.1.4 Output 1.4: Integrated malaria information storage system deployed down to health facility level

Table 05: Progress of KPI #12 over time per package of implementation

KPI	Baseline	Target	Year 1	Year 2	Final
KPI #12: % of HFs reporting monthly data through the iMISS	Int: N/A	80%	N/A	100%	91%

off track for target | on track for target | target reached | N/A

The rollout of the iMISS at the HF level in Intensive package districts resulted in 91 percent of HFs reporting monthly data through the iMISS (KPI #12) by the end of the project, surpassing the target of 80 percent (Table 05). As part of the rollout, 119 health workers were targeted for training at HFs across six of the Intensive package districts.

Although the project surpassed the final year target, the proportion of HFs reporting monthly data through the iMISS fell from an initial 100 in year 2. This was mainly the result of tablet theft or breakdown in the implementing facilities. In response to these issues, the iMISS Taskforce wrote an SOP for repairing and replacing devices. As a result of this SOP being implemented, improvements were seen in districts and HFs reporting problems over the course of the final year.

Results indicate that the iMISS implementation at the HF level can have a positive impact on data quality. An in-depth analysis of DQA data collected throughout the programme implementation showed that only 54.8 percent of HFs were originally reporting accurate data in SIS-MA, but this proportion increased to 81.6 percent after the iMISS introduction at HF level. In comparison, HFs reporting accurate data in SIS-MA where the iMISS had not been introduced increased from 60.8 percent to 76.6 percent in the same period. This increase in HFs where the iMISS had not been introduced was not found to be significant.

Data entry at HF level in KaMaxaquene district

While it is not possible to assume causality between use of the iMISS at HF level and improvements in data quality, it is conceivable that the fewer data processing layers there are, the fewer opportunities there are for error. However, in a country like Mozambique where nearly 1,800 HFs exist, a large portion of which have no power or internet connection, countrywide rollout of the iMISS at HF level seems unfeasible in the short term. Despite this, the iMISS data entry at HF level may be a useful tool to improve data quality in low transmission settings where data quality has been shown to be a major issue, and where phased implementation is feasible to ensure feedback from users to adjust tools for user acceptability.

3.2 Outcome 2.0: Improved data accessibility, data use and data to action across all strata

Table 06: Progress of KPIs #13 and #14 over time, per package of implementation

KPI	Baseline	Target	Year 1	Year 2	Final
KPI #13: % of districts with the iMISS fully functional and available	Std: 0%	90%	0%	97%	100%
	Std+: 0%	100%	0%	100%	100%
	Int: 0%	100%	0%	100%	100%
KPI #14: % of D2A interventions planned that were followed up	Std: 0%	20%	N/A	N/A	N/A
	Std+: 0%	75%	58% [1]	0%	N/A
	Int: 0%	90%	82% [1]	0%	100%

off track for target | on track for target | target reached | N/A

[1] Data collected through the revision and follow-up of action plans post district-level monthly meetings

By the end of the project, the iMISS was fully functional and available in 100 percent of districts in all three implementation packages (KPI #13) and was able to provide key summary information to decision makers (Table 06). In Intensive package districts, 100 percent of the D2A interventions planned were followed up, although this fluctuated over the course of the project (KPI #14).

Ensuring that the iMISS was fully functional and available in 100 percent of districts across all packages (KPI #13) was a key achievement for the project, as the development of an integrated data platform to compile all malaria-related information was one of the main recommendations arising from the 2018 surveillance assessment.[vii]

The fluctuation in achievement levels in the proportion of D2A interventions planned that were followed up on (#KPI 14), can be justified by the change in the approach used to measure this indicator. From year 2 onwards, this indicator was solely related to the interventions implemented in Intensive packages, particularly those implemented by the REACT surveillance approach managed by CISM.

While the development of the iMISS and the supporting tools was a phased and complex process that required engagement, harmonisation and approval from different partners, the process was a crucial part of this project and was important to the uptake and integration of this system by the end of the project and beyond.

vii Malaria Consortium. Malaria surveillance system performance in Mozambique: a comprehensive assessment. London: Malaria Consortium; 2018. Available from: https://www.malariaconsortium.org/resources/publications/1169/malaria-surveillance-system-performance-in-mozambique-a-comprehensive-assessment.

3.2.1 Output 2.1: Integrated malaria information storage system and associated tools and dashboards defined, developed and tested

Table 07: Progress of KPI #15 overtime

KPI	Baseline	Target	Year 1	Year 2	Final
KPI#15: # of the iMISS validated tools/elements integrated into the system	N/A	10	3	4	10

off track for target | on track for target | target reached | N/A

By the end of the project the iMISS was fully developed, implemented and in use across Mozambique. This was essential to tackle problems of data dispersion, fragmentation and the underutilisation of relevant malaria data at all levels. To achieve this, a total of 10 tools/elements was developed and integrated over the course of the project (KPI #15) (Table 07). Several of these tools and dashboards are outlined in the list below:

- An individual malaria case dashboard showing individual data aggregation in the city of Maputo that aimed to facilitate the identification of potential areas of residual transmission prior to the iMISS rollout
- A dynamic DQA dashboard allowing visualisation of good or poor performance by province, district and HF. This dashboard enabled information by intervention package to be aggregated and allowed for the visualisation of progress over time, to ensure data could be collected and visualised prior to the iMISS rollout
- System architecture, historical data, and data forms and data entry mechanisms were aligned to ensure that they could all be visualised in a single iMISS platform
- Specific iMISS modules and dashboards were developed incorporating user feedback.

In addition to these tools, the project supported their uptake through the following key activities:

iMISS training provided to nearly 1,300 district and provincial staff, as well as to 900 HF and district staff in Intensive package districts

- iMISS Taskforce established with the MoH and implementers to ensure the iMISS was effectively implemented and supported the development and implementation of an M&E plan
- Supervision of the iMISS for 250 health workers supported across 76 districts to identify site challenges and system bottlenecks.

iMISS district level training in Lichinga, Niassa

Many actors were engaged to ensure the improvement and uptake of the iMISS and these associated tools and platforms. This involved engagement and collaboration from many partners, including CHAI, Saudigitus and Malaria Consortium, as well as engagement with the MoH (NMCP and the Department of Information Systems) and with users.

An evaluation of the iMISS was designed to assess the quality of inputs from the iMISS implementation at HF level and to assess if iMISS information and dashboards could effectively support decision-making at all levels of implementation. From this, the following key learnings were found:

- Data quality was assessed as good. The iMISS reporting at HF level seemed to improve data quality over time, when compared to the usual data reporting processes
- Training of the iMISS users and the rollout of the system need to be done in close succession to avoid learning losses
- A lack of IT skills among some users resulted in challenges to ensure adequate access and use of the system. Challenges in accessing the correct link or loss of username and password were common. Moreover, basic IT skills related to the overall functioning of tablets and Android systems were missing for some staff. It was agreed that future training and supervision should include a basic IT skills package
- Infrastructure problems, such as a lack of power supply and internet access, were found in some locations and constitute difficult challenges to overcome since they require higher engagement from other entities in the Government of Mozambique
- The data availability and syncing time between SIS-MA and the iMISS need to be improved. Data quality components, such as reporting rates, reporting timeliness and the completeness of reporting were only reported in SIS-MA and not available in the iMISS, limiting discussions on data quality. These issues were addressed after the iMISS assessment and, subsequently, improved
- The development of interim tools while the iMISS was under development proved to be important to inform the design of the iMISS. As these tools were implemented, they helped to start a data-oriented culture in the different settings and facilitated the transition to the iMISS dashboards and associated tools
- Taskforce meetings were instrumental in identifying implementation issues with the iMISS and for following up on the solutions implemented through regular liaison with district focal points. Coordination with field users showcased that the issues identified need to be tackled at the lowest implementation level (district/HF). Adding layers to the process of problem identification, action planning and implementation of action results in delays in addressing problems that may be easy to resolve. Specific SOPs were drafted to ensure logistical problems could be fixed quickly, but it is essential that, at a minimum, someone skilled can provide support to solve day-to-day user issues with the iMISS at a provincial level. The engagement of other government departments in Mozambique (namely the Department of Statistics and the Department of Information Technology) was important to ensure that appropriate follow-up was done beyond NMCP capacity. Their inclusion proved to be valuable as they can support the management of devices at a more decentralised level (e.g.

screen freezing, synchronisation errors, identification of tablets that need to be replaced, etc.)

- Regarding DU, it was found that district meetings happened regularly, but mainly focused on operational issues. Data-driven discussions were frequently not carried out due to other pressing needs and priorities. Although the scenario gradually improved over time, this practice was hard to change and may be related to the need to ensure training on D2A for district managers, and to the need to have tailored guidance linked to the iMISS dashboards to guide these meetings.

The development and institutionalisation of the iMISS have been challenging, but very constructive, processes, ensuring integration of user feedback and recurrent adaptation to meet user needs. Establishing the iMISS Taskforce proved to be an important strategy to monitor the rollout of the iMISS. Close support and supervision were also deemed to be essential, particularly in this initial stage of system maturation.

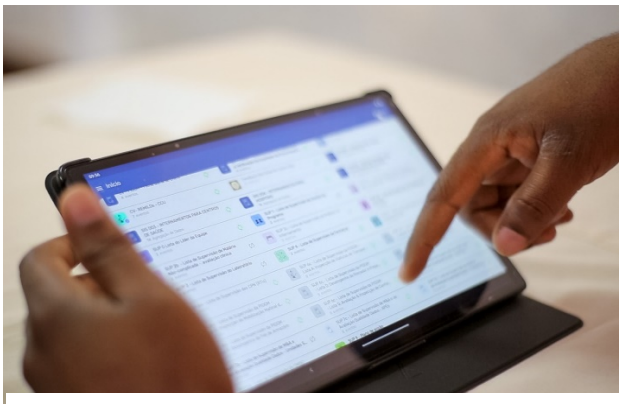
3.2.2 Output 2.2: Integrated malaria information storage system data integration and risk stratification of the outputs produced

Table 08: Progress of KPI #16 overtime

KPI	Baseline	Target	Year 1	Year 2	Final
KPI #16: % of districts with updated risk stratification	Int: N/A	100%	N/A	N/A	100%

off track for target | on track for target | target reached | N/A

Output 2.2 was focused on ensuring that districts could compile and use analysed data for decision-making. By the end of the project, risk stratification dashboards had been produced, with 100 percent of districts receiving the updated risk stratification (KPI #16) (Table 08). An individual case notification form was also developed by the end of the project. These tools allowed for a better understanding of malaria epidemiology at a more refined, granular level, allowing for a better rationale for decision-making.



iMISS dashboards and functionalities in use

The risk stratification dashboards were the main tool to guide decision-making at the district level. An example of this dashboard, in Portuguese, can be seen in Figure 06. Feedback was collected from end users to refine the best ways to present data and promote data discussions. These active surveillance dashboards focused on case notification and classification metrics and were adjusted to low transmission settings where active surveillance approaches will be implemented. Robust, stepwise development of data entry forms and associated dashboards was done to obtain feedback from partners. As active surveillance activities still have limited implementation, ongoing review of these dashboards should be done through TWG meetings.

To speed up data visualisation while the iMISS was under development, an individual case notification system was developed in year 1 for Maputo City. This system was implemented across several HFs in the KaMavota district and was useful to provide insights into the challenges associated with the rollout of elimination-oriented surveillance activities in the Mozambican context. This exercise enabled some individual case information to be plotted and to map potential case origins to guide specific intervention implementation. This was useful way of producing a visualisation tool for malaria risk transmission in urban settings.

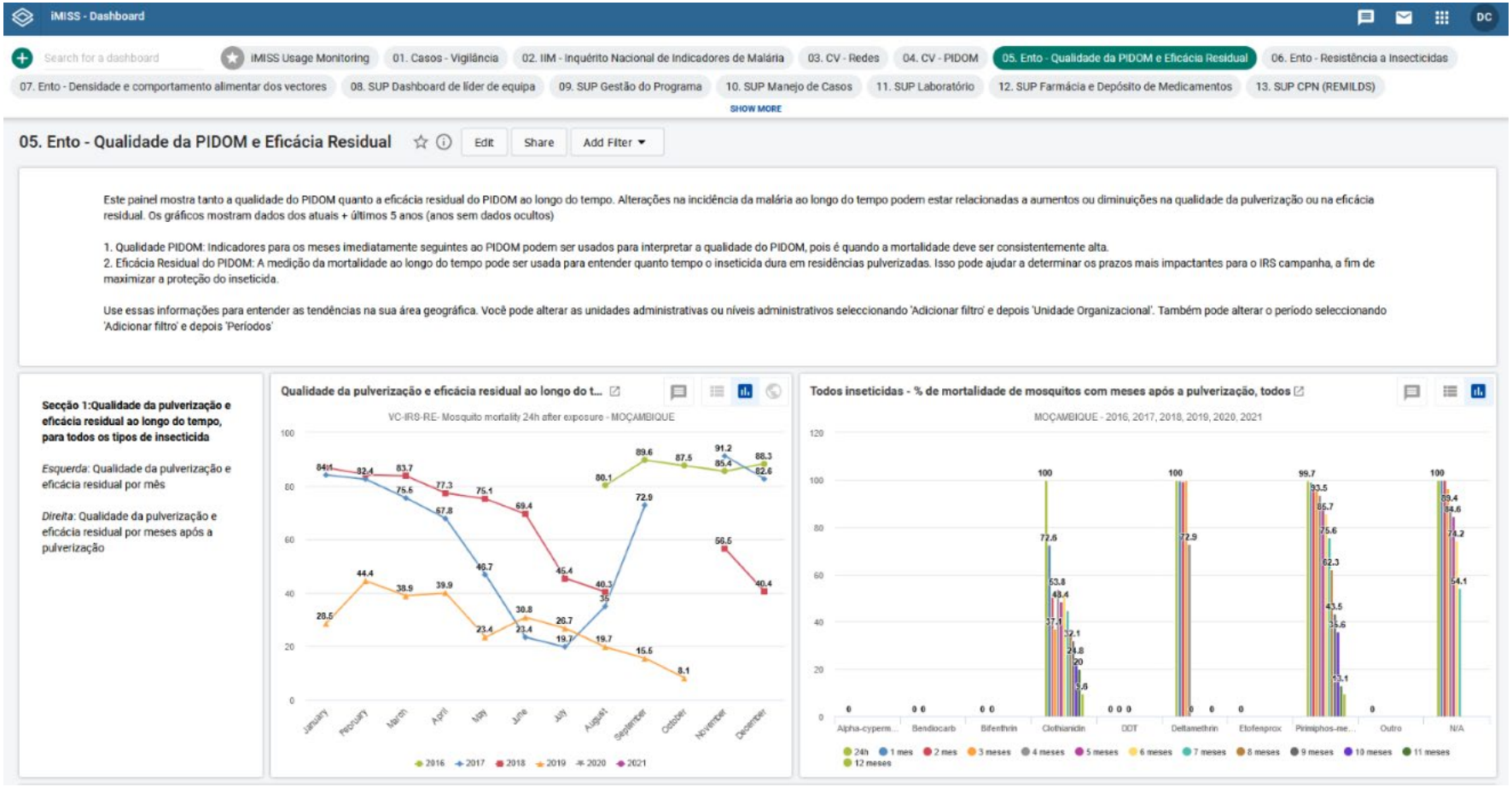


Figure 05: Example of thematic dashboard used for data visualisation (in Portuguese)

3.2.3 Output 2.3: Improved operational planning through data use and data-to-action activities

Table 09: Progress of KPI #17 over time, per package of implementation

KPI	Baseline	Target	Year 1	Year 2	Final
KPI #17: % of districts conducting D2A monthly meetings	Std: N/A	50%	N/A	N/A	N/A
	Std+: N/A	90%	0%	91%	100%
	Int: N/A	100%	66%	96%	100%
KPI #18: % of districts conducting annual planning based on existing data	Std: N/A	60%	N/A	N/A	N/A
	Std+: N/A	100%	22%	100%	100%
	Int: N/A	100%	18%	100%	100%

off track for target | on track for target | target reached | N/A

By the end of the project, 100 percent of districts in both the Standard plus and Intensive packages were conducting monthly D2A meetings (KPI #17) (Table 09). This increased from zero percent in year 1 in the Standard plus package, and from 66 percent in the Intensive package. Similarly, 100 percent of districts in both Standard plus and Intensive districts were conducting annual planning based on existing data by year 3 (KPI #18).

In year 3, over 200 D2A meetings were supported across Standard plus and Intensive districts. These were facilitated by the development and operationalisation of the following tools:

- A ToR and guidance checklists for the district D2A monthly meetings
- An adaptive learning framework to document lessons learnt throughout the project implementation
- A revised ToR for the DQA implementation manual
- A ToR for district experience exchange across packages
- A draft version of a manual malaria bulletin to guide discussions on malaria epidemiology at district and provincial level. In the absence of an available iMISS, this bulletin was essential to guide initial discussions until the iMISS was rolled out.

To promote data discussion in these meetings, the guidance focused on fostering epidemiological trend analysis as a starting point for discussions. The analysis of overall trends was then narrowed down to each HF, to understand which HFs could be contributing to the identified trends. Data quality issues, testing rates and stockouts of rapid diagnostic tests, population movements and vector control coverage interventions, among other topics, were framed into the discussion to try to identify the main drivers for specific changes.

The meetings held during year 1 enabled action plans to be developed and implementation response activities to be carried out (Success Story 03). These meetings helped to improve data accessibility, DU and D2A by the end of the project, in line with outcome 2. Action plans should continue to be used in the Standard plus and Intensive districts and could also be utilised to help follow up on the implementation of data discussion meetings in Standard package districts. If action plans are made

available through the iMISS in the future, it will be possible to track this progress and understand how districts are tackling some of the problems highlighted by the available data.

Success Story 03: Out-of-the-box solutions in Sofala province

One innovative solution that emerged from the D2A meetings in Sofala province was the setup of a WhatsApp group to share and discuss monthly reports. This strategy proved to be useful to improve the timeliness of report submission, as submission to the district level was not dependent on travel availability or capacity to carry the physical form. These out-of-the-box answers to common problems should be fostered to ensure data are available to guarantee adequate decision-making on a timely basis.

Once the iMISS was rolled out and uptake had begun, there was an increase in the use of data visualisation tools in the iMISS. However, it was clear that the iMISS functionalities and tools were not being used to their full potential. This suggests that refined guidance should be drafted with clear flowcharts for data analysis and decision-making, directly linked to the iMISS's capabilities and tools. This would allow managers at the district and provincial levels to use the iMISS to its full potential and use data for decision-making.

3.2.4 Output 2.4: Improved identification of outbreaks/hotspots for timely and effective response

Table 10: Progress of KPI #19 over time, per package of implementation

KPI	Baseline	Target	Year 1	Year 2	Final
KPI #19: % of outbreaks/hotspots of transmission identified on time that are confirmed by field investigations	Std: N/A	50%	N/A	N/A	N/A
	Std+: N/A	90%	N/A	N/A	N/A
	Int: N/A	90%	N/A	N/A	100%

off track for target | on track for target | target reached | N/A

By the end of the project, 100 percent of the outbreaks/hotspots of transmission had been identified on time and were confirmed by field investigations in Intensive package districts (KPI #19) (Table 10). The outbreak investigation processes showed the importance of urgency when identifying outbreaks and implementing follow-up actions.

The project completed the development and integration of an early warning system (EWS) into the iMISS and staff were trained on its use during an outbreak. The deployment of the EWS had challenges, including deprioritisation and delay due to COVID-19. Despite this, potential areas suitable for indoor residual spraying (IRS) were identified in year 1 using individual data collection and mapping. In years 2 and 3, the EWS was finalised.

The need for improved guidance and clear approaches on how to deal with outbreaks was highlighted when an outbreak was documented and investigated in the Magude district. In future, it is recommended the existing outbreak detection and response procedures should be linked to the

EWS to guide detection, investigation and response in a timely and robust manner. Existing resources for outbreak response should also be promoted to ensure procedures are not delayed.

3.2.5 Output 2.5: Operationally feasible model for conducting case and foci investigations developed

Table 11: Progress of KPIs #20 and #21 over time per package of implementation

KPI	Baseline	Target	Year 1	Year 2	Final
KPI #20: % of cases notified that are investigated and classified	Int: N/A	75%	N/A	0%	100%
KPI #21: % of active foci that are responded to	Int: N/A	50%	N/A	0%	100%

off track for target | on track for target | target reached | N/A

Output 2.5 was addressed through the REACT surveillance research project led by CISM in Magude and Matutuíne districts, Maputo province. By the end of the project, 100 percent of cases notified were investigated and classified (KPI #20), and 100 percent of active foci were responded to in the Intensive package districts in the REACT study (KPI #21) (Table 11). This REACT component had good feasibility and acceptability. This suggests that the intervention is operationally feasible as it was widely accepted by the communities and they believed it contributed to the reduction of malaria cases. The key findings relevant to this project were as follows:

- The implementation of an intense malaria surveillance strategy requires adequate mobilisation of funding, as expectations from volunteers engaged in the study and in charge of case follow-up nearly undermined study implementation
- Some areas were hard to reach and required adequate logistical and financial resources to ensure investigations could be conducted. This is particularly important for cases classified as local, since they are indicative of a focus of transmission that needs adequate and prompt investigation and response
- Operational challenges related to power and internet availability can limit the reporting and, consequently, the triggering of case investigation. Such limitations require out-of-the-box solutions that need to be tailored to these specific contexts
- The initial absence of a module in the iMISS that could support these case reports and consequent investigations led to the development of a parallel system from CISM. This proved to be essential as active surveillance components in the iMISS only became available in year 3. All the data collected have since been imported from the CISM database into the iMISS.

The implementation of the REACT surveillance research project allowed for the identification of some potential foci of transmission where the study was implemented (Figure 07).

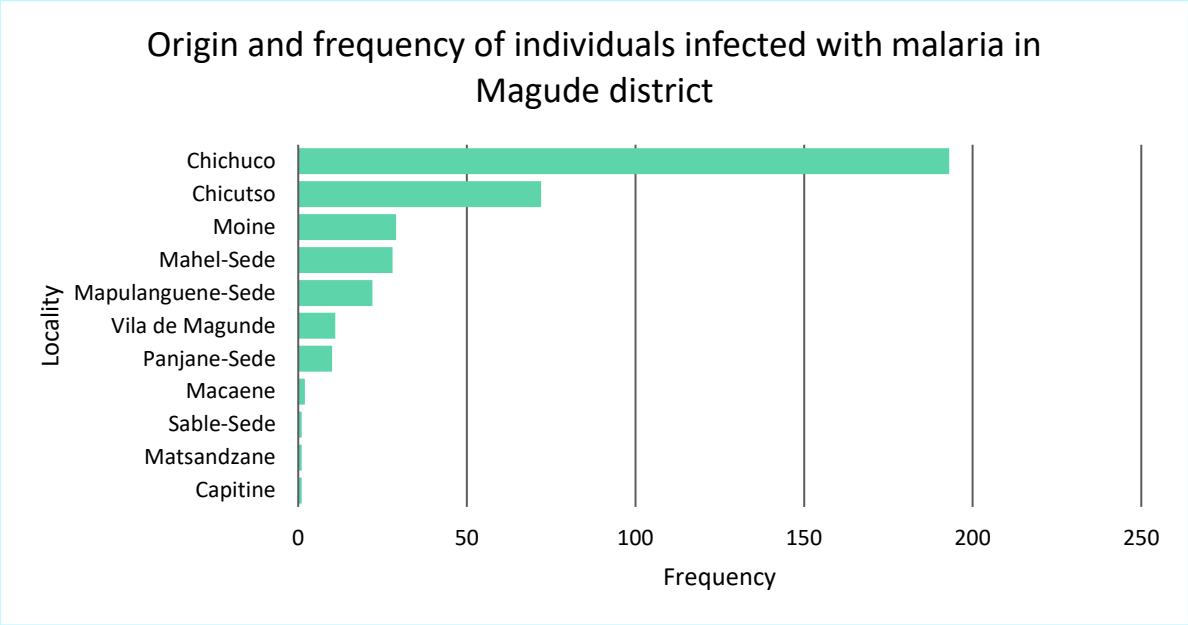


Figure 06: Place of origin of individuals infected with malaria in Magude district

The main barriers to implementation were the unpleasant effects of antimalarial drugs among those targeted for mass drug administration (MDA); fear of ingesting the drug without being sick; and discomfort in ingesting the drug under the observation of the implementing staff. Furthermore, absenteeism of key household leaders, lack of incentives for workers, impassibility of some access routes and limited information about the effectiveness of the drug were also key challenges.

A cost analysis was conducted to determine the economic impact of the reactive focal MDA in the districts of Magude and Matutuíne, in southern Mozambique. The total estimated economic cost of reactive focal MDA during a one-and-a-half-year implementation period would be 115,202 USD from the health system perspective. Approximately 2,753 people were treated during the programme implementation period, translating to an estimated cost of 41.85 USD per person treated and 1.28 USD per population at risk. Personnel-related costs were the main cost drivers, accounting for 40 percent of the total costs. Transport and personnel costs (salaries and allowances), and training and supervision were the second and third cost drivers, respectively, and represented slightly more than one-fifth of the total costs. Training to use IT equipment and supervision represented around 13 percent and 11 percent of the cost, respectively. These costs will inform a final cost-effectiveness analysis that aims to assess the value for money of these interventions from the healthcare perspective in terms of health outcomes and the use of healthcare resources.

Finally, an impact assessment was scheduled to be carried out in Matutuíne using a controlled interrupted time series analysis, with Namaacha district as a control and the monthly malaria incidence from the routine surveillance system (the district health information system) at the HF catchment area level as the dependent variable. Unfortunately, Namaacha district was deemed an inappropriate control for Matutuíne, since it was observed during the analysis that the two districts were not comparable on some covariates and on malaria incidence in the pre-intervention period. The analysis will be redone using a new, adequate control or a synthetic control. If no comparable control is found, an uncontrolled interrupted time series regression with counterfactual analysis will be done.

3.2.6 Output 2.6: Malaria action plan implemented in urban areas (Maputo City)

Table 12: Progress of KPI #22 over time in Maputo City

KPI	Baseline	Target	Year 1	Year 2	Final
KPI#22: % of measures defined in the action plan that are effectively implemented	Maputo City: N/A	100%	0%	0%	100%

off track for target | on track for target | target reached | N/A

By the end of the project, 100 percent of measures were effectively implemented in Maputo City (KPI #22) (Table 12). Specific manuals and tools were designed to collect individual case data in Maputo City to assess spatial and temporal trends in reported malaria cases. Staff from several health centres in Maputo City were trained to implement these reporting tools. Although there were challenges in the uptake of these case-based reporting tools, a gradual alignment between cases individually notified and cases reported through SIS-MA was noted (Figure 08). This demonstrated a normalisation of this reporting system.

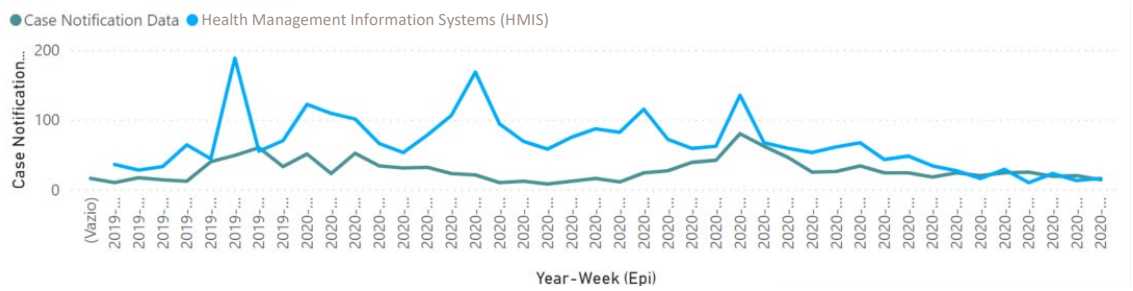


Figure 07: Comparison between case line listing and aggregated cases in six health facilities in Maputo City (last updated in week 36, 2020)

X-axis = the epidemiological weeks of the year; Y-axis = number of cases reported

A total of 2,380 cases were reported in years 1 and 2. Only 65.6 percent of cases reported travel outside of the city in the past month, with nine reporting international travel. Maps of the 1,314 cases that were successfully geolocated showed distinct spatial patterns when comparing cases in non-travellers (Figure 09). This information was regularly shared with the NMCP to inform refinement of the areas targeted for spraying.

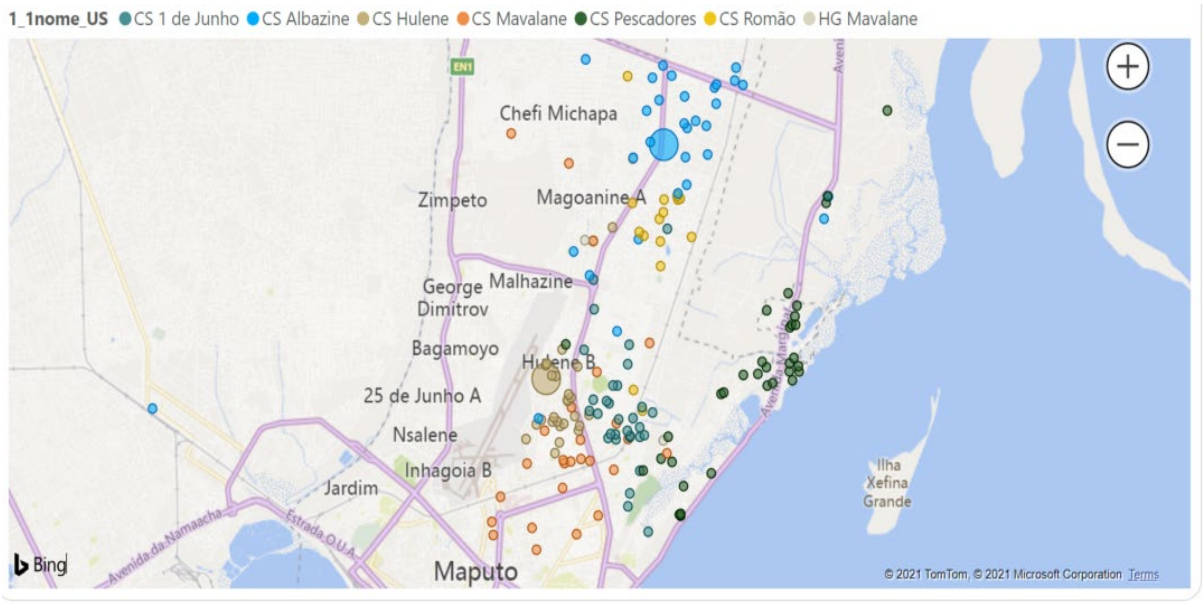


Figure 08: Clustering of local cases (cases reported to have not travelled in the past two weeks) using case line listing data

Case notification and mapping played an important role in identifying potential hotspots for transmission in urban areas, refining target areas for IRS and providing useful learnings to take forward. With the iMISS development, it is expected that case geolocation data, which was manually collected in this project, can be integrated into the system in the future.

The rollout of these tools proved to be challenging due to the high number of patients and, consequently, high workloads in targeted facilities. High staff turnover and the high number of consultation rooms also made data compilation per HF harder. Despite the initial challenges in the uptake of this strategy by health workers, a gradual increase in reporting was noted, but then compromised by the COVID-19 pandemic. As Malaria Consortium teams regularly visited the HFs and explained the purpose of the exercise, the health workers started to understand the importance of accurately collecting and reporting information. Feedback on this exercise and on the data collected proved to be essential to ensure full engagement from HF staff working on case line listing.

Simple paper reporting tools were used. These were frequently collected, compiled and then plotted in a map using Power BI. Moving forward, the integration of advanced tools into the iMISS may be needed so that reference points can be attributed to a case, as was done through this manual exercise (e.g. a restaurant, market, etc.) given the low reliance on postal addresses in Mozambique. Rolling out case line listing in the iMISS at HF level is essential to ensure data is compiled and reported in a timely manner for investigations and responses. This is particularly important in HFs with several outpatient consultation rooms where the compilation of data proved to be challenging and contributed to the initial discrepancies found between case reporting and SIS-MA reporting.

Urban malaria is challenging to tackle due to the high population density and numerous, hard-to-find mosquito breeding sites. Tool refinement is needed as a blueprint for elimination surveillance in these specific contexts and to ensure cases and hotspots of transmission can be properly traced and responded to. This may include the development of HF-based reporting tools at the individual level, where individuals can identify their approximate location of residence. Such systems would allow for the gradual identification of potential places of transmission and trigger investigations. This is particularly important with the emergence of an invasive species that may be more adapted to

urban contexts and can pose a real threat to malaria control in big urban centres such as Maputo City. Mapping cases is important to trigger targeted entomological surveillance activities and the identification of persistent mosquito breeding and malaria transmission sites.

3.2.7 Output 2.7: Granular malaria data routinely reported, accessible and reviewed

Table 13: Progress of KPI #23 over time, per package of implementation

KPI	Baseline	Target	Year 1	Year 2	Final
KPI #23: % of implementation units (districts/provinces) accessing and using granular malaria data	Std: N/A	50%	N/A	N/A	92.5%
	Std+: N/A	90%	N/A	N/A	100%
	Int: N/A	100%	N/A	N/A	100%

off track for target | on track for target | target reached | N/A

By the end of the project all package districts had met the target percentage of implementation units (districts/provinces) accessing and using granular malaria data (KPI #23) (Table 13). To reach the target percentage, districts and provinces conducted their meetings based on granular data analysis to better identify and implement corrective actions.

Meetings were used for coordination and information sharing between partners, as well as mapping country progress towards strategic objectives for malaria surveillance. Convening partners in such a platform also allowed broader discussions and reviews of key tools, such as the individual case notification form, the design of a malaria bulletin, the finalisation of the SM&E manual, the M&E plan and the design of the iMISS training packages.

In one case, these meetings were used to identify an important discrepancy in the number of deaths being recorded. The investigation that was conducted showcased that available DQA data reported the malaria deaths as 38 percent higher than those reported through SIS-MA (376 through DQA vs 232 through SIS-MA). As a result of this investigation, 11 out of 12 assessed hospitals were found to be underreporting through SIS-MA. This initiated intense discussions on implementation measures and the root causes of these discrepancies.

Moving forward, the NMCP should ensure that these meetings continue and are guided by the robust data included in the iMISS to identify problems in a timely manner, gather insights from partners and develop adequate response actions. During the final months of the project, Malaria Consortium worked with the NMCP to implement a transition plan to ensure continuation of the activities at all levels. For example, the new NMCP strategic plan will integrate data discussion meetings at all levels to increase the culture of DU.

Data review meetings with the technical working group were central to ensuring that malaria data was routinely reported, accessible and reviewed. As well as being an opportunity to discuss the main data trends, these meetings were also an important opportunity to identify major problems and programmatic gaps and challenges that required a harmonised approach from partners. Although COVID-19 impacted the format of these meetings (shifting to online meetings) and reduced the engagement from participants, they still proved to be an important platform for discussion.

3.3 Outcome 3.0: Sustained capacity for surveillance at all levels

Table 14: Progress of KPI #25 over time, per package of implementation

KPI	Baseline	Target	Year 1	Year 2	Final
KPI #25: % of districts conducting at least one DQA, DU and D2A activity in the past month	Std: 0%	25%	N/A	N/A	N/A
	Std+: 0%	80%	44%	44%	100%
	Int: 0%	80%	50%	55%	100%

off track for target | on track for target | target reached | N/A

The percentage of districts conducting DQA, DU and D2A activities improved dramatically over the course of the project. By the end of the project 100 percent of districts in the Standard plus and Intensive packages had conducted at least one DQA, DU or D2A activity in the previous month (KPI #25) (Table 14). At the start of the project, no districts were conducting such activities.

Developing and institutionalising a data culture across all staff engaged in malaria surveillance activities has been a major achievement for this programme. It was crucial to ensure that the development, pilot and rollout of tools that had taken place throughout the project could have the required impact, enabling the NMCP staff at all levels to lead on implementing surveillance strategies on the ground. The increased proportion of districts conducting DQA, DU and D2A activities (KPI #25) shows that district/provincial teams gradually adhered to and improved the implementation of activities as they became aware of the benefits of promoting a data culture. It is expected that the same trend will be verified in the future as the iMISS integrated tools support surveillance-oriented activities moving forward.

A key question for this output was whether surveillance-related activities could be monitored after programme closure. The project sought to ensure sustainability through use of a transition plan focused on promoting MoH leadership in the planning and execution of activities. Standard package districts served as a working model for this, demonstrating how the NMCP would implement tools and activities with MoH resources. While tracing surveillance implementation in Standard package districts was not possible, an increase in the number of districts rolling out DQA and D2A activities when they became available in the iMISS was observed towards the end of the project. It will be essential to ensure that supervision occurs and that DQA activity results flow frequently into the iMISS to ensure gradual uptake of this data-driven approach by the MoH. The integration of a supervision tool in the iMISS will help to better understand the progress in this area. It will also enable the identification of districts with poorer performance and the subsequent design of targeted approaches from the central level down to the areas in need.

3.3.1 Output 3.1: Relevant staff trained across all levels on data quality

Table 15: Progress of KPI #26 over time per package of implementation

KPI	Baseline	Target	Year 1	Year 2	Final
KPI #26: % of district targeted staff trained on DQA, DU and D2A in the past year	Std: 0%	20%	10%[1]	100%	100%
	Std+: 0%	100%	90%[1]	66%	100%
	Int: 0%	100%	100%[1]	46%	100%

off track for target | on track for target | target reached | N/A

[1] Considered as one staff per HF and four staff per district as the target number of people to be trained

Part of a training session focused on correct outpatient consultation book registration

By the end of the project, 100 percent of targeted district staff had been trained on DQA, DU and D2A in the previous year (KPI #26) (Table 15). This was achieved in all packages, with the Standard package districts significantly surpassing the original target of 20 percent.

DQA, DU and D2A training was deemed as essential from the beginning of the programme. The 2018 surveillance assessment found that essential surveillance knowledge and practices (including DU and planning based on data) were widely missing across all levels in Mozambique.[viii]

In total, 435 people were trained in year 2, mainly in Standard package districts. In Standard plus and Intensive districts, the percentage of staff trained in year 2 was below target. This was because the focus was mainly to ensure refresher training, as these districts had been targeted in year 1. In year 1, training was provided to 427 districts and provincial managers with Global Fund support.

While no training was conducted in year 3, training in the previous two years of the programme ensured that all districts had at least one person trained to use the iMISS and the DU and D2A elements. More broadly, these trainings helped to build a data culture and the use of data for decision-making.

[viii] Malaria Consortium. Malaria surveillance system performance in Mozambique: a comprehensive assessment. London: Malaria Consortium; 2018. Available from: https://www.malariaconsortium.org/resources/publications/1169/malaria-surveillance-system-performance-in-mozambique-a-comprehensive-assessment.

3.3.2 Output 3.2: Implement supportive components to enhance data quality, data use and data-to-action activities

Table 16: Progress of KPI #27 over time per package of implementation

KPI	Baseline	Target	Year 1	Year 2	Final
KPI# 27: % of districts conducting routine supportive supervision visits to HF, focused on DQA, DU and D2A	a) Std: N/A	a) 40%	a) N/A	a) N/A	a) N/A
	b) Std+: N/A	b) 100%	b) 56%	b) 94%	b) 100%
	c) Int: N/A	c) 100%	c) 100%	c) 100%	c) 100%

off track for target | on track for target | target reached | N/A

At the end of the project period, 100 percent of districts in the Standard plus and Intensive packages were conducting routine supportive supervision visits to HFs that focused on DQA, DU and D2A (KPI #27) (Table 16). This target was achieved in year 1 for the Intensive package and was maintained throughout the project. In the Standard plus package, this improved steadily over the three years.

Throughout year 3 and during the extension period, Malaria Consortium focused on creating the conditions needed to ensure a smooth transition of this programme to government officials. Focus was put into intensifying activities such as supervision and data discussion meetings. Throughout the transition period, Malaria Consortium's involvement decreased substantially to ensure adoption of activities and increased leadership from local authorities.

Experience exchange in Maxixe district

In year 2, supervision focused on DQAs and discussions at the district level to ensure training retention and to mitigate problems. Supervision included 24 monthly meetings and two quarterly meetings at district level that focused on analysing and improving data analysis and the use of data for decision-making. Malaria Consortium and provincial-level staff fostered discussions to ensure a work plan was drafted and implemented by district managers. These discussions identified the need to have adequate and specific tools for these exercises. Flowcharts with identified discussion points can be used to foster discussions in such exercises.

Experience sharing between districts, which was originally promoted in year 1, also continued in year 2. Through this activity, staff from two districts met and shared their experiences of implementing DQA, DU and D2A activities. Districts with different levels of performance were identified to promote experience sharing. Participants reported that this improved the recognition from all participants that more had to be done in those districts that had gaps in performance. In year 2, this activity focused on joint DQAs and discussions around how to improve supervision and meeting exercises to contribute to a gradual improvement of data quality and decision-making.

A social behaviour change communication (SBCC) plan for DU was also developed in year 2, building on the main challenges and system bottlenecks identified in the supervision visits that began in year 1.

During the rollout of these supervision visits in year 1, 13 supervisions were carried out at HF level and six were carried out at the district level. Supervisions focused on DQA interventions, as well as improving data visualisation and analysis at the district level by plotting data in basic graphs and tables, and providing support to interpret the findings.

3.4 Outcome 4.0: Evaluation of intervention packages and dissemination of evidence

3.4.1 Output 4.1: Adaptive learning integrating insights into programme improvement

Table 17: Progress of KPIs #29 and #30 over time, per package of implementation

KPI	Baseline	Target	Year 2	Final
KPI #29: % of districts implementing/using defined SBCC strategies and tools for DU and D2A	Std: N/A	20%	0%	N/A
	Std+: N/A	100%	0%	100%
	Int: N/A	100%	0%	100%
KPI #30: % of HFs implementing/using defined SBCC strategies and tools	Std: N/A	20%	0%	N/A
	Std+: N/A	100%	0%	54%
	Int: N/A	100%	0%	66%

off track for target | on track for target | target reached | N/A

One key output from the adaptive learning approach taken in this project was the development of an SBCC approach to improve data for decision-making and to build a better understanding of the direct implications that good data can have for communities. This approach was informed by the learnings that were produced from year 1 and was used to support the development of a tailored approach focused on system bottlenecks for effective DU. By the end of the project, 100 percent of districts in the Standard plus and Intensive packages were using defined SBCC strategies and tools for DU and D2A (KPI #29) (Table 17). At HF level, this was 54 percent in Standard plus districts and 66 percent in Intensive package districts (KPI #30).

The rollout of the iMISS was an opportunity to refine this SBCC strategy and the SBCC approach. Data compiled during the rollout, and the feedback provided by users, were used to improve the strategy and frame it with activities that could stimulate the use of the iMISS. An improved strategy was designed to include roles and responsibilities and a timeframe for activity implementation (Figure 10).

A key innovation implemented within this revised strategy was the rollout of a data competition to stimulate improvements in quality of data. This competition was launched once the iMISS was in place to ensure DQA findings could be properly traced and to ensure a fair competition. The competition proved to be a good approach to encourage the careful review of data before

submission, leading to improved data quality in districts. A final prize was awarded to the winning district in a ceremony led by the NMCP in December 2022.

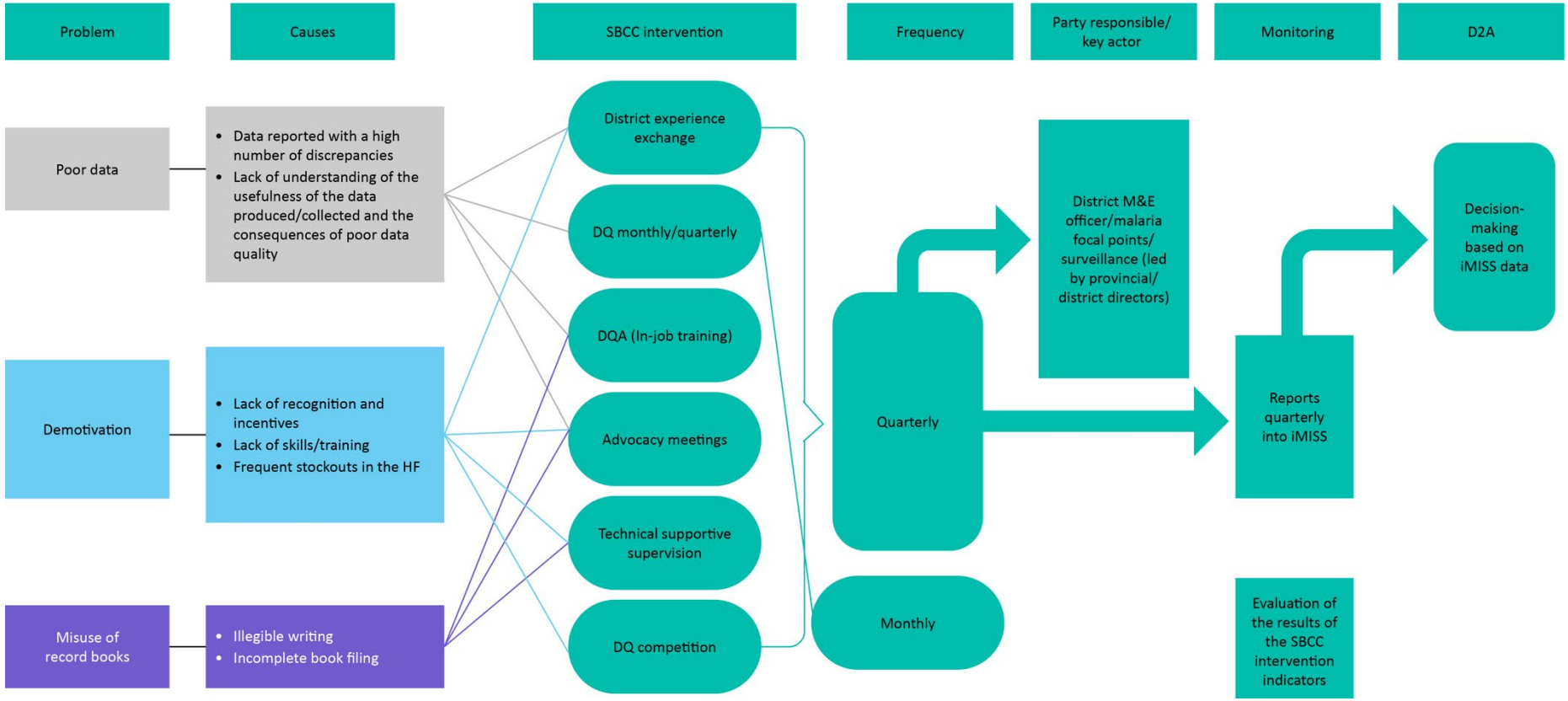


Figure 9: Social and behaviour change communication approach flowchart for decision-making

HF = health facility; SBCC = social and behaviour change communication; DQ = data quality; DQA = data quality assessment; M&E = monitoring and evaluation ; iMISS = integrated malaria information storage system

Prior to this more detailed, iMISS-focused SBCC approach, a first iteration of the SBCC guidance was developed. This initial guidance produced a set of activities that could be implemented at different levels and detailed approaches to ensure activity implementation. The strategy was not prescriptive as it aimed to provide the needed flexibility to each district/province according to context. The summarised flowchart for the project's original SBCC approach is presented below (Figure 11).

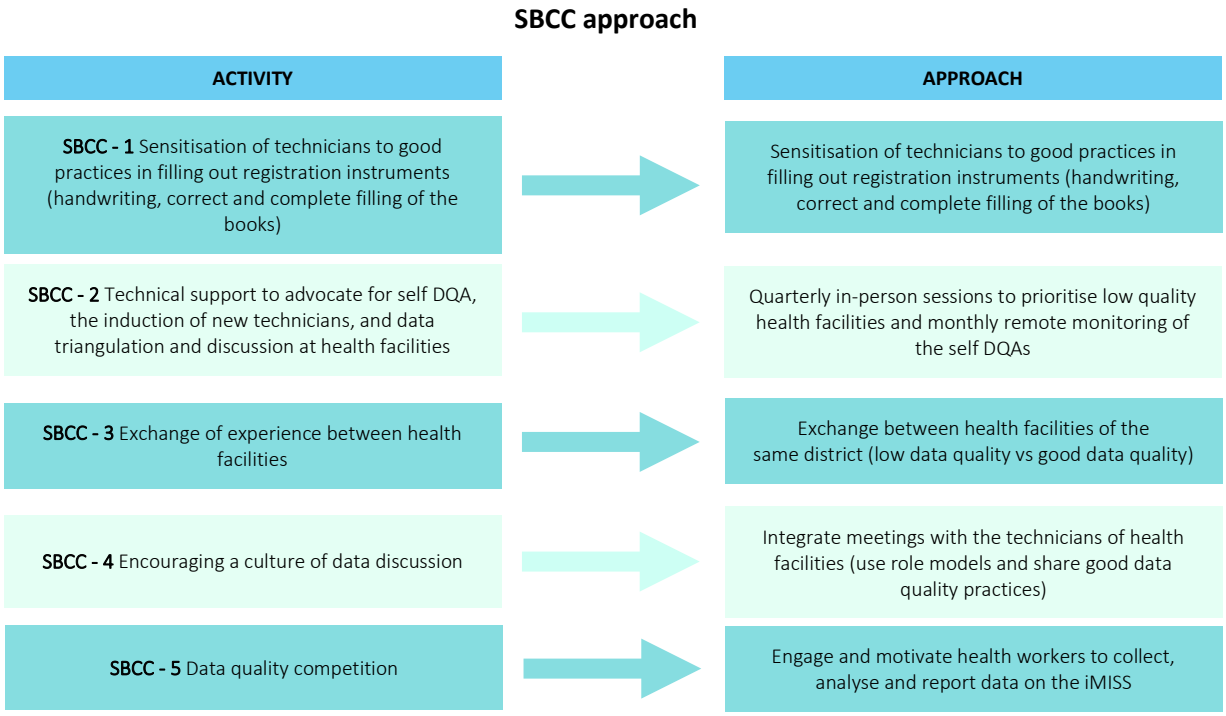


Figure 10: The initial social and behaviour change communication approach for data use for decision-making

3.4.2 Output 4.2 Evidence generated for guiding strategic and operational decision-making

Table 18: Progress of KPI #31 over time

KPI	Baseline	Target	Year 1	Year 2	Final
KPI#31: % of studies published/disseminated internally and externally	N/A	80%	N/A	0%	80%

off track for target | on track for target | target reached | N/A

Generating evidence to best decide on operational models for surveillance activities has always been at the core of this programme. The project reached its target to publish or disseminate 80 percent of the studies produced (Table 18). The two key activities that took place under this output in the final year of the project were the implementation of the REACT surveillance grant (which began in year 2) and the cost analysis exercise. These pieces of work will be important in supporting the NMCP to make informed decisions around surveillance and priority setting now that the project has come to an end.

An HF capacity assessment focused on surveillance capacity was initially planned to better understand the root bottlenecks for effective surveillance systems at the HF level. However, it was not done at the request of the NMCP, as the country had gone through several health surveys and conducting another was deemed nonessential.

The research conducted under the REACT surveillance grant aimed to assess the feasibility of a surveillance-for-elimination model based on case confirmation, classification and close follow-up. This operational research was designed with CISM, who also led the research programme working in close collaboration with Malaria Consortium and CHAI. The protocol for testing malaria surveillance strategies was developed in year 1 and the request for ethical approval was sought in-country and internationally. The objective of the study was to design an optimal package for malaria surveillance in Mozambique with a key focus on assessing surveillance for elimination strategies. Based on case classification, active foci were identified and targeted with focal MDA. The feasibility, acceptability and viability of these interventions were assessed through qualitative approaches. A parallel cost-effectiveness exercise was also conducted and will be linked to the impact assessment analysis. The impact analysis will use a quasi-experimental design comparing the incidence based on index cases in targeted districts to non-targeted neighbouring districts with similar epidemiological characteristics. The preliminary results of this research were presented in September 2022 and it is expected that the final results will be published throughout 2023. These results will help the NMCP make informed decisions about surveillance methods to speed up elimination activities in southern Mozambique.

Due to delays caused by the COVID-19 pandemic, the cost analysis exercise was delayed until year 3. This piece of work focused on collecting unit costs for a complete costing exercise per activity and per package. A thorough compilation of the costs incurred in the first years of implementation was conducted by an external consultancy company. Once the costs were compiled and analysed, the consultancy company provided several scenarios to inform the NMCP, combining either packages of interventions or essential activities. The final output produced a range of costed scenarios ranging between 3.5 million USD (as the minimum cost per year to implement a set of essential activities across all districts), to a maximum cost of nearly 22 million USD per year if Intensive and Standard plus packages were implemented across all districts. This information and the other scenarios provided should be utilised by the NMCP to understand how to set priorities and define the interventions while leveraging existing resources.

4 Lessons learnt

The major lessons learnt from this project implementation can be divided into three key areas: operational, technical, and appropriation and scale-up. We also provide major recommendations for the future of NMCP implementation. Learnings throughout the project were guided by the adaptive learning framework developed in year 1, which detailed processes and tools for regular sharing from activity implementation. Malaria Consortium encouraged teams to regularly report on activities, compiling key learnings that arose from activity implementation, either through reports or during team meetings. Learnings were compiled and discussed internally (Malaria Consortium teams) and externally with partners to define the required processes and operations adaptations. Malaria Consortium compiled several learning briefs throughout the project as a strategy to consolidate learnings and consequent adaptations, as well as to share experiences with the wider public. In general, a continuous learning approach was used, with Malaria Consortium partners (NMCP, CHAI, CISM) capturing, consolidating and re-adapting implementation strategies based on the contextual need. As part of this continuous learning approach, lessons from the programme's interventions were documented.

4.1 Operational

4.1.1 Operational lessons

- Upscaling a malaria surveillance system at country level requires the harmonisation and coordination of several tools, partners and strategies. It requires time to develop, pilot and rollout in the system. This is particularly important when developing an information system that requires several adjustments. While the main outputs were produced in the timeframe initially planned, the project would have benefited from a longer duration to work with a fully functional iMISS across all the strata of transmission. Tools for outbreak detection and active surveillance were tested as a proof of concept but could not be scaled up in operational 'real life' settings, as these components were the last to be developed in the iMISS
- The scale-up of a new information system is always challenging as it does not solely depend on the system functioning. We have learnt that infrastructure issues such as the lack of power supply and internet, as well as human resource issues such as a lack of IT skills, have a great impact in the uptake of new tools. While HF infrastructure is hard to tackle as it requires greater investments supported by the local government, IT skills and ongoing support can and should be provided beyond the rollout of the health information system (the iMISS in this case)
- The availability of essential resources for an effective malaria surveillance response (materials, tools and other resources for active surveillance) are essential to ensure the surveillance system functions. This was initially reflected in the availability of essential reporting tools that were procured. However, it was also highlighted by the early gaps in the REACT surveillance implementation and in the setup of mechanisms to repair or replace IT materials such as tablets. A robust surveillance system should ensure the key essentials resources exist and that the supply of these reporting tools is constant. Reporting tools should be backed up by functional logistics that are as close as possible to the end user (at HF or district level).

4.1.2 Operational recommendations

- Pilot the scale-up and use of surveillance approaches in broader geographic areas and assess the impact across the transmission range. This should include measuring the use of the iMISS, and also the implementation of DU and D2A with little to no support from partners. This will help to understand the routine bottlenecks faced by authorities to scale up these activities in the real context
- Develop, pilot and roll out innovative tools for iMISS use, such as short demonstration videos (built like FAQs) embedded into the system, or a support hotline that can help with troubleshooting
- Secure an equipped team from the central to the district level. This team should ensure problems are rapidly reported and responded to, guaranteeing that stockouts of reporting tools or tablet damage are quickly fixed.

4.2 Technical

4.2.1 Technical lessons

- Recurrent DQA improved data quality. A single DQA to an HF may not have the intended result of a sustained improvement in data quality. The messaging should be clear that recurrent visits should be carried out to sustain gains in results. This is particularly important when external resources are not available and DQA may not be seen as a priority. As shown with this project, routine DQA helps improve data but also helps to create a sense of the programmatic importance of good data
- In low transmission settings, data errors have a greater impact on data accuracy. As malaria transmission decreases, the awareness of the importance of accurate data reporting should be reinforced. Messaging for health workers should be strengthened and supported with continuous training and supervision. This is particularly important in urban settings, as could be seen with the urban malaria approaches implemented. Significant adjustments and innovations are needed to ensure that high-quality, detailed data are gathered in urban HFs, which have high attendance but do not consider data quality and detail to be priorities.

4.2.2 Technical recommendations

- Integration of DQA into regular HF supervision can be a solution to ensuring continued focus on the quality of data. As shown during the project, however, such integration can lead to a minimisation of the importance of DQA when integrated with other HF supervision components that may be perceived as more important (e.g. drugs or case management). Another potential solution developed during this programme implementation is the scale-up of self DQA guidance that can be run at minimal additional cost. Complementary to this, the inclusion of self DQA data into the iMISS could improve the understanding of HF performance and direct on-site visits towards those not performing as well in terms of quality of data
- Develop specific tools for low transmission setting reporting that i) facilitate health workers line listing cases and their characteristics and ii) ensure key relevant data are collected. This could include the development of specifically built iMISS modules/tools to report cases at HF data and customised tools for urban settings to support the identification of potential malaria transmission hotspots
- DQA activities must be conducted in periods with lower patient loads at HFs to allow access to all data elements and to ensure the availability of involved HF staff

- DQA should not be conducted during the monthly reporting period (20–21 of each month) given that, during that period, relevant HF staff are not available to conduct DQA.

4.3 Appropriation and scale-up

4.3.1 Appropriation and scale-up lessons

- Coordination was a central point to guarantee all project outputs were delivered. The TWGs and the iMISS Taskforce were essential to ensure harmonisation of approaches and were able to quickly respond to the challenges raised. As the project is now closed, the NMCP must take the lead on these discussions moving forward to ensure a similar level of support and coordination in the field
- The intense support provided in some districts proved that improvements in malaria surveillance in Mozambique can be quickly achieved and hopefully sustained with minor or no support at all. However, it was not clear if similar results can be achieved across the remaining districts with minimal to no support. The costing exercise helped to provide a sense of cost drivers to scale up similar intensive interventions in more districts of Mozambique and should help the MoH to prioritise interventions and allocation.

4.3.2 Appropriation and scale-up recommendations

- Strategic objectives for TWGs and taskforces should be drafted alongside clear agendas and monitoring plans so that the NMCP can, over time, lead and monitor progress towards the objectives and make the needed adjustments based on key indicators
- A malaria surveillance workplan should be drafted assuming different costing scenarios to plan for a gradual scale-up in surveillance system functioning. Such a workplan should be linked to clear performance indicators that could be monitored in the TWG and taskforce meetings so that the NMCP and partners can objectively understand the progress being made. The costed plan should help the NMCP to make priority decisions in resource allocation and ensure that scale-up is gradual but effective, by allocating resources in a rational manner
- A final, structured evaluation of the programme is highly recommended to assess the system gains of this programme. However, this evaluation should be implemented one to two years post programme closure. Such an evaluation should aim to understand the impact of the project in the Intensive package districts, and also the broader gains achieved in Standard package districts and with the iMISS development and scale-up.