

Malaria Data Flow and Treatment Barriers at Khadkala Primary Health Centre, Pune District

A Facility-Level Cross-Sectional Study of Health Worker Reported Practice

Research Question: What are the key barriers in malaria case reporting (data flow) and treatment processes in Pune, and how are digital reporting systems used in practice?

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Study Site: Khadkala Primary Health Centre and associated sub-centres,
Pune District, Maharashtra, India

n = 50 health workers

Fieldwork: 1–14 July 2026

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Abstract

Malaria surveillance is the foundation of India's elimination strategy, which targets zero indigenous cases by 2027 and elimination by 2030. The Integrated Health Information Platform (IHIP), launched across India in April 2021, moved surveillance from weekly aggregated paper reporting to case-based digital reporting. How it operates in daily practice at facility level is far less documented than how it was designed to operate.

This report examines malaria case reporting and treatment at Khadkala Primary Health Centre and its associated sub-centres in Pune District, Maharashtra. A structured questionnaire of 23 items was administered to 50 health workers, of whom 41 were ASHAs, between 1 and 14 July 2026. Responses are reported descriptively. No inferential statistics were applied, since purposive selection at a single site does not support generalisation. Findings are separated into three classes: items answered individually by all 50 respondents, items recorded once at facility level and repeated across records, and three items completed by only 10 respondents.

Among individually elicited responses, 49 of 50 respondents reported IHIP in use within the facility's malaria reporting workflow, the same number reported the four M-series paper formats in use, and 48 reported messaging applications. One respondent reported digital entry occurring at the point of care. Duplicate paper and digital entry was reported by 32 respondents, delays in forwarding information upward by 22, and referral delay by 25. At facility level, same-day notification of confirmed cases, informal sharing through messaging before formal digital entry, entry by a dedicated data entry operator, and connectivity, staffing, workload and training barriers were each recorded as a single uniform response. No drug stock-out was identified by any respondent.

The workflow described is a hybrid one in which paper recording, immediate informal notification and formal digital capture operate as parallel pathways rather than in sequence of replacement. Same-day notification and non-point-of-care digital entry are compatible, and this study does not establish the interval between them. Findings describe one facility network during one transmission season and rest on reported practice rather than verified system behaviour. The implications identified concern connectivity, duplicate recording, training, district feedback and private-sector notification.

Introduction

Malaria is a mosquito-borne parasitic disease caused by *Plasmodium* species and transmitted through the bite of infected female *Anopheles* mosquitoes. It is both preventable and curable, yet it remains one of the largest infectious disease burdens worldwide, and India carries the largest share of that burden in the WHO South-East Asia Region.

Two different figures describe malaria in India, and the distinction between them matters for this study. For 2024, WHO estimated approximately 2.0 million malaria cases in India, with an uncertainty interval of 1.5 to 2.6 million, alongside an estimated 3,400 deaths. Over the same year, India's national programme reported 255,500 cases and 86 indigenous deaths (WHO 2025). These are not competing counts of the same thing: the first is a modelled estimate of disease occurrence, the second a tally of cases captured by the reporting system. Their difference illustrates a substantial discrepancy between estimated burden and programme-reported cases, and WHO treats the explanation of that discrepancy as methodologically complex rather than as a direct measure of surveillance sensitivity. It is nonetheless the reason that surveillance strengthening, rather than case management alone, sits at the centre of India's elimination strategy.

One line in the same WHO country profile bears directly on the findings of this study. India records case reporting from the private sector as mandatory, while the confirmed private-sector cases submitted in the national data for 2024 number zero (WHO 2025). Whatever the reporting arrangements in principle, private-sector malaria diagnoses are not reaching the national count in practice.

India has nonetheless made substantial progress. Programme-reported cases fell from 1,169,261 in 2015 to 176,522 in 2022, a reduction of approximately 85% (NCVBDC 2023). This progress has been driven by the National Framework for Malaria Elimination in India 2016–2030 (Government of India 2016) and, more recently, by the National Strategic Plan for Malaria Elimination 2023–2027, developed by the National Center for Vector Borne Diseases Control with support from the WHO Country Office. The Strategic Plan sets the objective of interrupting indigenous transmission and achieving zero indigenous malaria cases nationally by 2027, working toward elimination by 2030, and identifies the transformation of malaria surveillance as its first strategic approach (NCVBDC 2023).

Control programmes can succeed while counting cases imperfectly; elimination programmes cannot. Once transmission approaches zero, every case becomes an event requiring detection, notification, investigation and response, and a case recorded on paper but not entered into the national system in time is not visible to the managers responsible for acting on it. The existing architecture has been documented as a constraint on this: India's malaria surveillance data have been described as fragmented across multiple players and held in silos, lacking near-real-time reporting and interoperability between systems (Rahi, Das and Sharma 2022). The problem is compounded by the private sector, since national malaria data are collated principally from public health facilities through an aggregated paper-based system that captures only a small proportion of the cases actually diagnosed (Rahi and Sharma 2022).

To address these weaknesses, the Government of India introduced the Integrated Health Information Platform (IHIP). IHIP is not a separate rival system to the Integrated Disease Surveillance Programme (IDSP); it is the digital platform that anchors data entry and management for IDSP, providing near-real-time surveillance information to decision-makers at all levels of government (WHO India 2021). Soft-launched across India from April 2021, it moved surveillance from the earlier IDSP model of weekly aggregated reporting on presumptive, probable and laboratory-confirmed forms to case-wise digital reporting, and it supports case-based reporting for 33 diseases and syndromes, malaria among them (Goel, Chaudhuri and Saxena 2022; Tanu, Sagar and Kumar 2023). Malaria-specific information is handled through the vector-borne disease module, which carries the programme-specific attributes that general syndromic surveillance does not capture.

That is the system as designed. How it functions in daily practice at facility level is a separate question, and one that is far less well documented. Digital platforms in low-resource health systems routinely encounter conditions their designers did not assume: intermittent connectivity, staff carrying clinical and administrative workloads simultaneously, paper systems that continue in parallel rather than being retired, and informal communication channels that fill the gap between an event occurring and a record being made (WHO 2019). Whether IHIP has replaced the paper reporting chain, or has been layered on top of it, is not something that can be established from programme documentation.

This study examines that question at one site. Working at Khadkala Primary Health Centre and its associated sub-centres in Pune District, Maharashtra, it asks what barriers health workers identify in malaria case reporting and treatment, and how digital reporting is used alongside paper-based recording in their daily work. The research question is: what are the key barriers in malaria case reporting (data flow) and treatment processes in Pune, and how are digital reporting systems used in practice? The evidence presented is drawn from a single primary health centre network and is offered as a detailed account of one site rather than as a characterisation of Pune District or Maharashtra as a whole.

Types of Traditional Approaches in Malaria Surveillance

Malaria surveillance in India rests on a set of standardised paper formats issued by the National Center for Vector Borne Diseases Control, designated M-1 through M-4, together with parallel formats for asymptomatic cases (M-1A to M-4A). These formats predate digital reporting and remain in use alongside it. Their design is worth setting out in some detail, because it establishes what information the paper system is intended to capture and at what points in the workflow, which in turn defines what the digital system was introduced to replace.

Table 1. The M-series malaria reporting formats

Format	Completed by	Purpose	Timing
M-1	ASHA, volunteer, MPW, medical officer	Primary case record. All suspected cases, whether or not tested or treated. Captures active or passive detection, fever duration, test date and result, slide dispatch and receipt dates, pregnancy status, treatment start date, antimalarials dispensed, suspected severe malaria, referral date, death date. Carries a stock position table.	Fortnightly
M-2	ASHA, volunteer, MPW; returned by laboratory	Slide examination request and laboratory feedback. Completed in duplicate. Provider fills columns 1–7 and sends one copy with the slides; laboratory technician completes columns 8–12 with results and smear quality; provider records date result received back.	Per specimen
M-3	Laboratory technician	Laboratory register of slide examination. Date of examination, village and provider codes, slide number, patient details, fever duration, dispatch and receipt dates, species results including P.	Continuous

		falciparum stage, date result sent to provider.	
M-4	Sub-centre, PHC, district, state	Aggregating report carrying data upward. Thirty-five columns including fever cases recorded in M-1, RDTs and results by species, slides taken and examined, microscopy results, cases by age and sex, cases in pregnancy, severe cases treated, outbreaks, referrals and deaths. Carries a stock position table.	Fortnightly

Note: Source: NCVBDC, Advisory with Malaria Formats M1–M4. Parallel formats M-1A to M-4A exist for asymptomatic case reporting.

One column of the M-4 deserves particular attention in the context of this study: number of slides reported within 24 hours. The paper reporting system therefore already contains an explicit timeliness indicator. Reporting speed is not a concern introduced by digitisation; it is a metric the paper formats were designed to capture.

1. **Community-level active and passive case detection.** The formats above are operated within a fieldwork structure built on ASHAs and multi-purpose health workers. Under NCVBDC guidance, active case detection is carried out by an assigned multi-purpose health worker through fortnightly domiciliary visits, while passive case detection occurs when patients present at a facility. The M-1 distinguishes between the two for every case recorded. ASHAs conduct fever surveillance in their villages, perform rapid diagnostic tests, prepare blood slides for laboratory confirmation, initiate treatment where indicated, and refer suspected severe cases.
2. **The manual notification chain.** Consolidated M-4 data move upward through a defined administrative sequence: sub-centre to primary health centre, PHC to block, block to district, and district to state. Each step involves compilation of the level below. In the traditional model, the speed at which a case becomes visible to district or state authorities is therefore governed by the fortnightly reporting cycle rather than by the date of detection. A case detected on the first day of a fortnight and one detected on the last are transmitted upward together.

Taken as a whole, the M-series captures the full clinical and diagnostic timeline of a case: fever onset, testing date, result return, treatment start and referral. The information needed to assess timeliness is present in the paper system by design. What it does not provide is speed of

transmission, since data that exist at the periphery within days reach higher levels on a fortnightly cycle.

Types of Digital Approaches in Malaria Surveillance

Digital approaches to malaria surveillance in India are organised around a principal national digital surveillance architecture rather than a set of competing systems. Understanding how that platform relates to the programmes that preceded it is necessary before the findings of this study can be interpreted.

1. **The Integrated Health Information Platform (IHIP).** IHIP is a web-enabled, near-real-time electronic surveillance system launched across all states and union territories of India on 1 April 2021. It is not a parallel alternative to the Integrated Disease Surveillance Programme; it is the platform that anchors data entry and management for IDSP, providing near-real-time surveillance information to decision-makers at every level of government (WHO India 2021). The distinction matters because the two are often described as separate systems: structurally, IHIP is the digital architecture through which IDSP surveillance now operates (Goel, Chaudhuri and Saxena 2022).

The change IHIP introduced was in the unit and cadence of reporting. Under the earlier IDSP model, surveillance data moved upward as weekly aggregated counts. IHIP replaced this with case-based reporting, capturing individual cases with demographic, clinical and laboratory detail, geocoded and reported daily, across more than 33 diseases and syndromes including malaria (Goel, Chaudhuri and Saxena 2022; Tanu, Sagar and Kumar 2023).

2. **The S, P and L reporting forms.** Within IHIP, surveillance data are captured through three linked forms. The S-form records syndromic information and is reported from sub-centres by ANMs. The P-form records presumptive cases, and the L-form records laboratory-confirmed results. The three are linked within the platform so that a case can be followed from syndromic presentation through presumptive identification to laboratory confirmation. Reporting responsibility sits principally with ANMs, medical officers and laboratory technicians or laboratory in-charges.
3. **The Malaria module (IHIP-Malaria).** Three modules of IHIP are currently functional: the IDSP module, the Malaria module operating under the national vector-borne disease

programme, and the National Programme for Climate Change and Human Health. Malaria-specific information is handled through the vector-borne disease module rather than through general syndromic surveillance alone, because programme management requires attributes that syndromic surveillance does not capture, including species identification, treatment regimen, radical cure and foci classification. NCVBDC describes near-real-time case reporting through IHIP-Malaria as enabling prompt decision-making and foci response, and identifies the platform as a basis for forecasting, modelling and climate-linked risk assessment (NCVBDC 2025). Positive cases identified through IDSP surveillance move into the malaria module, where programme-specific attributes are added. This is the sense in which malaria reporting is integrated with rather than separate from IDSP.

4. **Direct facility and laboratory integration.** IHIP is designed to connect with other health information systems, including hospital management systems and laboratory information management systems, so that diagnostic data can feed into the national surveillance network without re-entry. Where implemented, this removes the need for duplicate transcription between a facility's own records and the surveillance platform.
5. **Informal digital communication.** Alongside the sanctioned platform, messaging applications and email function widely as practical communication channels between levels of the health system. These are not official reporting tools and carry no formal status in the surveillance architecture: a case communicated by message is not a reported case until it is entered into IHIP. They are nonetheless significant in practice, because they transmit information immediately and can operate on an ordinary mobile data connection where a device configured for platform entry is not to hand. Their role at the study site is documented in the results of this study.
6. **The data entry model.** IHIP relies on entry by facility staff, including ANMs, medical officers and laboratory technicians, rather than by a separate cadre. Where in practice entry is delegated to a dedicated data entry operator, a structural interval is introduced between the point of care and the point of digital capture, because information must be transferred from the person who detected the case to the person who records it. Evidence from other Indian settings indicates that the competence and support of whoever performs entry is decisive. A quality improvement study in Raigarh, Chhattisgarh found that IHIP

captured only 44% of laboratory-tested malaria cases recorded in PHC laboratory registers, identified inadequate laboratory technician knowledge of IHIP data entry and poor feedback from the district surveillance unit as root causes, and achieved full sensitivity within five weeks through refresher training and a weekly district feedback mechanism (Patel et al. 2026).

Considered together, the digital and traditional approaches address different limitations. The M-series paper formats capture a detailed clinical and diagnostic record at the periphery but transmit it on a fortnightly aggregation cycle. IHIP was designed to preserve case-level detail while removing the transmission delay. Whether it achieves this at a given facility depends on conditions the platform design assumes but does not control: connectivity, device availability, staff time and familiarity with the system.

Literature Review

The scale of the surveillance gap

A central problem in Indian malaria surveillance is that cases which are detected and treated may not be recorded in the national system. Rahi, Das and Sharma (2022) describe a system in which data are captured in fragmented fashion by multiple players operating in silos, without near-real-time reporting and without interoperability between the systems involved. The consequence is visible in the arithmetic of the national figures: the estimated burden for India substantially exceeds what the national programme records, and an earlier assessment, drawing on the World Malaria Report 2017, put the proportion of actual cases captured by routine surveillance at around 8% (Rahi and Sharma 2022). For an elimination programme, in which each individual case must be detected, investigated and responded to, a surveillance system operating at that level of capture is the binding constraint on progress.

Evaluations of malaria surveillance in Indian states

A small but growing body of state-level evaluations gives a consistent picture of where surveillance systems succeed and where they fail. Sharma et al. (2023) evaluated the malaria surveillance system in Punjab using CDC guidelines, scoring seven system attributes. Flexibility scored well at 85.9%; simplicity, acceptability, data quality and timeliness scored in the moderate range between 70% and 77%; and representativeness and stability scored poorest, at 59% and 57%.

The pattern is instructive. The system was not failing at the level of design or willingness, since staff accepted it and it adapted to change, but at the level of coverage and consistency of operation.

Kaur, Baharia and Dattani (2024) assessed malaria surveillance and laboratory services across three districts of Gujarat, scrutinising the M-1 to M-4 formats alongside ASHA and multi-purpose worker records to trace how blood smear collection, examination and reporting were documented. Their approach reflects a point relevant to the present study: the paper formats themselves are the primary evidence of what the surveillance system captured, and examining them is how gaps become visible.

Gahwai et al. (2026) conducted the most directly comparable study, evaluating malaria surveillance across six districts of Chhattisgarh, a state carrying 18% of India's malaria burden and 40% of its malaria deaths. Using CDC evaluation guidelines across 1,276 syndromic, 110 presumptive and 100 laboratory reporting units, they assessed timeliness as the proportion of forms reported within 24 hours of identification, alongside sensitivity, data quality and usefulness, and interviewed surveillance officers, epidemiologists and data managers at state and district level. Their results are directly relevant here: the surveillance system captured 5.8% of presumptive-form cases and 29% of laboratory-form cases.

Evidence on IHIP capture and its causes

The most specific evidence on the digital platform comes from Patel et al. (2026), who examined malaria reporting under IHIP in Raigarh district, Chhattisgarh. Comparing IHIP entries against PHC laboratory registers, they found that the platform captured 44% of laboratory-tested malaria cases in September 2023. More than half of confirmed cases recorded on paper at the facility therefore never reached the digital system. Root cause analysis identified two factors: inadequate laboratory technician knowledge of IHIP data entry, and poor feedback from the district surveillance unit to reporting facilities. Following refresher training and the introduction of a weekly district feedback mechanism, sensitivity reached 100% within five weeks.

This finding is important for two reasons. It demonstrates that the constraint on digital capture in an Indian PHC setting was competence and supervisory support rather than platform design or staff resistance. And it demonstrates that the constraint was tractable within weeks using ordinary programme resources.

The private sector gap

Rahi and Sharma (2022) identify a further limitation that facility-level evaluation cannot detect. India's malaria data are collated principally from the public health sector through an aggregated paper-based surveillance system, while a substantial share of cases are diagnosed and treated privately and never enter the national count. They argue that active engagement of private healthcare providers is a prerequisite for elimination, since a case treated outside the reporting system is invisible regardless of how well the public system performs.

Frameworks for understanding health information system performance

Two established frameworks inform how these findings can be interpreted. Aqil, Lippeveld and Hozumi (2009) propose the PRISM framework, which analyses routine health information system performance in terms of technical, organisational and behavioural determinants rather than technical factors alone, a structure that maps directly onto the barriers reported in the present study. Nutley and Reynolds (2013) address the related question of data use, arguing that improving the availability of health data achieves little unless the systems and incentives to act on it are also present. The Raigarh finding that a weekly district feedback loop was decisive is a practical illustration of that argument.

What remains undocumented

The existing literature evaluates surveillance systems principally against records, comparing what appears in registers with what appears in the digital platform, and does so at district or state scale. What is far less documented is how the workflow is experienced by the frontline staff operating it: which steps they identify as slow, which tools they actually use in sequence, and how formal and informal channels combine in daily practice. No published study was identified examining these questions at facility level in Pune District. This study addresses that gap, at one primary health centre network, from the perspective of the health workers themselves.

Hypothesis

Where digital capture has been measured against facility records in India, the shortfall has been traced to how data are entered rather than to whether a platform exists, and existing evaluations have worked at district and state scale rather than documenting the workflow from the perspective of the staff who run it. This study therefore examines the reporting and treatment workflow at one

primary health centre network through the accounts of those staff. Both hypotheses below are framed as expectations about what respondents will report rather than as claims about causation, because a cross-sectional questionnaire measuring perceptions cannot establish why a system behaves as it does.

1. **Hypothesis 1.** IHIP will be reported as widely used within the study site's malaria reporting workflow, while point-of-care digital entry will be less common, and operational barriers, including connectivity, workload, staffing and training, will frequently be reported.

IHIP has been the mandated platform for malaria case notification since April 2021, so a high proportion of respondents should report it as present in their workflow. Whether it is used at the moment of care is a separate question: the platform requires connectivity, a device and time, none of which are guaranteed at a working PHC during a transmission peak. Availability and point-of-care use are therefore treated as separate measured variables rather than as a single question about whether the facility uses IHIP.

2. **Hypothesis 2.** Health workers will identify delayed diagnosis, late patient presentation, staff shortages and referral delays more frequently than medicine availability as barriers to timely malaria treatment.

This hypothesis compares the relative salience of perceived operational barriers against medicine availability. It tests whether respondents locate the constraints on timely treatment in detection, care-seeking and human resources, or in commodity supply. The two would point to substantially different programme responses.

Both hypotheses are assessed against the primary data in the section that follows. Support for either is support for a description of this site during the study period. Neither hypothesis, if supported, constitutes evidence about other facilities in Pune District or elsewhere in Maharashtra, and the findings are not presented as such.

Data Methodology

Study Design

This study uses a descriptive, cross-sectional design based on primary data collected from health workers at a single primary health centre network. The design is appropriate for characterising how malaria case reporting and treatment processes operate in practice at one site, and for documenting the barriers that frontline staff themselves identify. It is not designed to estimate the prevalence of these barriers across Pune District or Maharashtra, and the findings are not presented as such.

The study measures reported practice and perceived barriers. It does not independently verify system behaviour: no IHIP timestamps, laboratory registers, drug stock records or case files were examined. Statements throughout this report about reporting timeliness, medicine availability and workflow reflect what respondents reported, not what was independently observed.

Study Setting

Data were collected at Khadkala Primary Health Centre and its associated sub-centres in Pune District, Maharashtra. The catchment is peri-urban and rural, served by a standard Maharashtra public health staffing structure of ASHAs and ANMs at community level, multi-purpose workers and a laboratory technician at facility level, and a medical officer with overall clinical responsibility. IHIP is deployed at the facility, and malaria case data are also recorded on the national M-series paper reporting formats.

Pune District experiences seasonal malaria transmission with a monsoon peak. Data collection took place between 1 and 14 July 2026, during this peak period, which is relevant to how respondents assessed caseload and workload at the time of interview.

Study Population and Sampling

Fifty health workers involved in malaria diagnosis, treatment, recording, reporting or follow-up were surveyed. Respondents were selected purposively to include the cadres that participate in the malaria surveillance workflow at this site. No randomisation was used and no sampling frame was constructed.

The final sample comprised 41 ASHAs (82%), 4 multi-purpose workers (8%), 2 ANMs (4%), and one each of Health Assistant, Medical Officer and Laboratory Technician (2% each).

This distribution reflects the actual composition of the frontline workforce at sub-centre level, where ASHAs substantially outnumber all other cadres. It also means that the sample is weighted heavily toward community-level case detection and follow-up roles rather than toward facility-level digital data entry.

No respondent held the designation of dedicated data entry operator, although six respondents (four multi-purpose workers, one health assistant and one laboratory technician) reported data entry or reporting as part of their role. All 50 respondents identified a dedicated data entry operator as the person who routinely enters malaria data into IHIP at this facility. The individual performing that function was therefore not directly represented in the sample, and findings concerning digital entry practice reflect the accounts of staff who observe or contribute to that process rather than the person who performs it. This is noted as a limitation.

Primary Data Collection

Primary data were collected using a structured questionnaire of 23 items across five sections: respondent profile; recording and reporting process; delays and barriers; digital tools in practice; and suggestions for improvement. Items used closed response options with tick-all-that-apply formats for barrier questions, and short free-text fields for suggestions.

The questionnaire was developed by the author with technical guidance from Dr. Samadhan Debaje, and drew on existing malaria reporting formats and IHIP data fields so that terminology would be familiar to respondents. It was designed to capture only the information necessary to address the research question, in order to keep administration brief in a working facility.

Data were collected by the author during field visits to Khadkala PHC and associated sub-centres between 1 and 14 July 2026. The author was present throughout and directed the collection, with questions administered in Marathi and field facilitation provided by Dr. Samadhan Debaje and a district programme colleague, Dr. Santosh. All data cleaning, analysis and interpretation were carried out by the author.

Responses were recorded on a digital form. Of the 50 records, 10 contain complete responses across all items including facility identification, years of experience and the question on how cases are first recorded. In the remaining 40 records, all of which are ASHA respondents,

these three fields are absent, and a number of items including the free-text responses are recorded identically across all records. This pattern indicates that some items were captured once at facility level and applied across records rather than elicited individually from each respondent. The precise circumstances in which those entries were made were not documented during fieldwork. These items are therefore reported in this study as a facility-level account reported uniformly, not as fifty independent judgements. The distinction is maintained throughout the results.

Secondary Data Collection

Secondary sources were used to establish epidemiological and programme context: the WHO World Malaria Report 2023 for global and regional burden; the National Framework for Malaria Elimination 2016–2030 and the National Strategic Plan for Malaria Elimination 2023–2027 for India's elimination targets and surveillance strategy; and WHO India and peer-reviewed sources for the architecture of the Integrated Health Information Platform. Secondary sources are used to describe intended system design; they are not used to make claims about how the study site actually operates.

Data Analysis

Responses were analysed descriptively. Results are reported as counts and percentages of respondents (n/N), with percentages rounded to the nearest whole number. For tick-all-that-apply items, respondents could select more than one option, so percentages do not sum to 100%.

No inferential statistics were applied. Confidence intervals and significance tests were considered and deliberately excluded. Both assume a sampling design that supports generalisation from a sample to a defined population; purposive selection at a single site does not meet that assumption, and applying such tests would convey a false impression of precision. Testing observed proportions against an arbitrary null value would not answer any meaningful question about whether, for example, connectivity constitutes a barrier at this facility. The descriptive counts are reported directly and are sufficient to support the analysis presented.

Limitations

Five limitations bear on the interpretation of these findings. First, the study was conducted at a single primary health centre network over a two-week period, using purposive rather than random

sampling, so the findings are not statistically representative of Pune District or Maharashtra and no estimate of barrier prevalence beyond the study site can be drawn from them.

Second, the sample composition reflects the frontline workforce rather than the reporting workforce. ASHAs constituted 82% of respondents, and their vantage point is community case detection and follow-up rather than digital data entry. No respondent held the designation of dedicated data entry operator, although all respondents identified such an operator as the person who enters malaria data into IHIP. Findings concerning digital entry therefore reflect the accounts of staff who observe or contribute to that process rather than the person who performs it.

Third, three profile items were completed by only 10 of the 50 respondents, all 40 missing records being ASHAs. No statement about the roles or experience of the sample as a whole can be made from those items.

Fourth, a number of items were recorded identically across all 50 records, indicating capture once at facility level rather than elicitation from each respondent. These are reported throughout as facility-level responses without counts or percentages. The precise circumstances in which those entries were made during fieldwork were not documented at the time, and this should be recorded in any future administration of the instrument.

Fifth, the study measures reported practice. No IHIP timestamps, laboratory registers, stock records or case files were examined, so no finding here establishes what the system did, only what respondents said about it. The questionnaire also did not ask whether the facility receives feedback on its reporting performance from the district surveillance unit, which limits what can be said about the behavioural findings in particular.

Ethical Considerations

Participation was voluntary and respondents were informed of the purpose of the study before administration. No patient records were accessed and no patient-identifying information was collected at any stage. Responses were recorded against respondent names within the working dataset; these have been removed from all analysis outputs, and no individual respondent is identified in this report.

Permission for the study was obtained as administrative approval through the district health administration. No institutional ethics committee review was sought or obtained. Dr. Samadhan Debaje provided technical review of the study protocol and questionnaire; this was a technical review and did not constitute formal ethics committee approval.

Data Presentation & Analysis

Fifty health workers at Khadkala PHC and associated sub-centres completed the structured questionnaire between 1 and 14 July 2026. This section presents their responses in relation to the two study hypotheses. All figures are counts and percentages of the 50 respondents. For items where respondents could select more than one option, percentages do not sum to 100%.

Three classes of evidence are distinguished throughout this section, and the distinction governs how each finding is reported. The first class is individually elicited data, where all 50 respondents answered and their answers differ; these are reported as counts and percentages of 50. The second class is items recorded uniformly across all 50 records, including the free-text responses and several barrier items; these indicate capture at facility level rather than individual elicitation and are reported as a single facility-level response, without a count or percentage. The third class is items completed by only 10 respondents, namely years in role, main malaria role, and how cases are first recorded; these are reported against a denominator of 10. Tables in this section state which class each item belongs to.

The reason for the distinction is that a value entered once at facility level and repeated across 50 records is one observation, not fifty. Reporting it as 50 of 50, or as 100%, would present a single response as unanimous agreement among fifty people. That would overstate the evidence, and the tables below therefore give facility-level items no numerator and no percentage.

Respondent Profile

Table 2. Respondent designation (n = 50)

Designation	n	%
ASHA	41	82%
MPW (Multi-Purpose Worker)	4	8%
ANM	2	4%

Health Assistant	1	2%
Medical Officer	1	2%
Laboratory Technician	1	2%
Total	50	100%

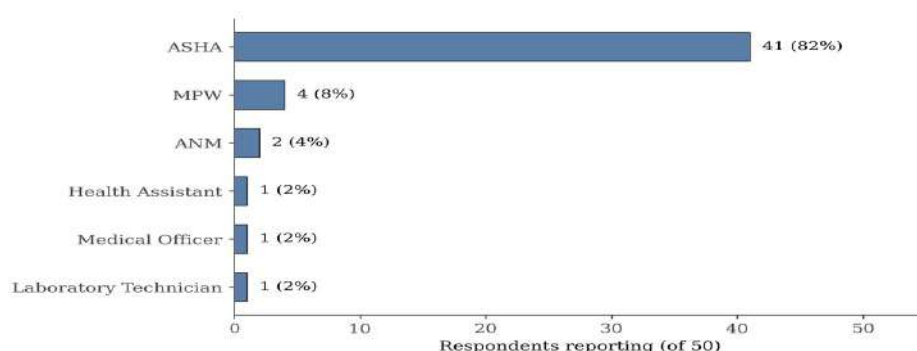


Figure 1. Distribution of respondents by designation (n = 50)

ASHAs constituted 82% of the sample, consistent with the composition of the frontline workforce at sub-centre level. Designation was recorded for all 50 respondents. Three further profile items, however, were completed by only 10 of the 50: years in current role, main malaria role, and how cases are first recorded. All 40 records missing these items are ASHA respondents. Findings on those three items are therefore reported against a denominator of 10 and not of 50.

Among the 10 respondents who answered, main malaria role was reported as follows: surveillance by 8, follow-up of cases by 8, data entry or reporting by 6, diagnosis or testing by 2, and treatment and patient care by 1, with respondents able to select more than one. Years in current role were reported as more than six years by the four MPWs, one to three years by the two ANMs and the laboratory technician, and less than one year by the medical officer. Because the ASHA cadre is absent from these three items, no statement about the roles or experience of the sample as a whole can be made from them.

Hypothesis 1: Digital reporting and data flow

H1. IHIP will be reported as widely used within the study site's malaria reporting workflow, while point-of-care digital entry will be less common, and operational barriers, including connectivity, workload, staffing and training, will frequently be reported.

Reported use of reporting tools

Forty-nine of 50 respondents (98%) reported that IHIP was used within the facility's malaria reporting workflow. The same proportion reported use of the M1, M2, M3 and M4 paper formats. The OPD register and WhatsApp or other messaging were each reported by 48 respondents (96%). Email was reported by 5 (10%), IDSP formats by 4 (8%) and the laboratory register by 1 (2%).

The near-identical reporting of IHIP and the M-series formats at 98%, alongside WhatsApp at 96%, is the central descriptive finding of this section: digital platform, paper formats and informal messaging are all reported as present in the same workflow rather than as alternatives to one another.

Table 3. Tools and formats reported as used in the malaria reporting workflow (n = 50)

Tool or format	n	%
IHIP	49	98%
M1 format	49	98%
M2 format	49	98%
M3 format	49	98%
M4 format	49	98%
OPD register	48	96%
WhatsApp or other messaging	48	96%
Email	5	10%
IDSP formats	4	8%
Laboratory register	1	2%

Note: Multiple responses were permitted; percentages therefore do not sum to 100%. Respondents were asked which tools are used within the facility's reporting workflow, not which they personally operate.

Timing of notification and digital entry

All 50 respondents (100%) reported that confirmed malaria cases are notified to the next administrative level on the same day, and 49 (98%) identified their immediate supervisor as the recipient. One respondent (2%) reported that data are entered into the digital system in real time at the point of care; the remaining 49 (98%) reported that entry occurs later. All 50 reported that cases are shared informally through WhatsApp or email before formal digital entry, and all 50 identified a dedicated data entry operator as the person who performs that entry.

Taken together, these responses describe a sequence rather than a contradiction. Case detection is followed by same-day notification, which respondents describe as occurring through messaging channels to a supervisor, with formal digital capture into IHIP performed subsequently by a dedicated operator. Same-day notification and non-point-of-care digital entry are compatible, and the interval between them cannot be established from this questionnaire. What the data support is that immediate notification and formal digital capture are distinct steps performed by different people through different channels.

Reported barriers to data flow

Four barriers were recorded for all 50 respondents: internet connectivity, staff shortage, high workload and gaps in training on reporting tools. These four are among the items recorded uniformly across all records and are therefore reported here as a facility-level account rather than as fifty independent endorsements.

The barriers that varied between respondents give a more differentiated picture. Duplicate paper and digital entry was selected by 32 respondents (64%), delays in forwarding information to higher levels by 22 (44%), incomplete or unclear forms by 13 (26%), unclear reporting process by 11 (22%) and lack of devices by 5 (10%).

Table 4. Reported barriers to timely malaria data flow, by evidence class

Barrier	n / 50	%	Evidence class
Duplicate paper and digital entry	32	64%	Individual
Delays in forwarding to higher levels	22	44%	Individual
Incomplete or unclear forms	13	26%	Individual
Unclear reporting process	11	22%	Individual
Lack of devices	5	10%	Individual
Internet connectivity	—	—	Facility-level
Staff shortage	—	—	Facility-level
High workload	—	—	Facility-level
Gaps in training on reporting tools	—	—	Facility-level

Note: Multiple responses were permitted; percentages therefore do not sum to 100%. Items shown as Individual were answered by all 50 respondents with differing answers. Items shown as Facility-level were recorded identically across all 50 records, indicating a single response captured at facility level; no numerator or percentage is given for these, since one response repeated across records is one observation rather than fifty.

An inconsistency requiring note

Question 10 asked directly whether the same malaria data is entered more than once across different registers or systems. All 50 respondents answered no. Question 12 offered duplicate paper and digital entry as a listed barrier, and 32 respondents (64%) selected it. These responses concern the same underlying practice and are not reconcilable from the data alone. The difference between an open question and a pre-specified option appears to have produced opposite answers, which suggests that endorsement of listed barrier options in this instrument should be interpreted with caution. Parallel use of paper and digital systems is evident from the tool data, since 98% of respondents reported both IHIP and all four M-series formats in use, but these data do not establish whether identical information is duplicated across them. This inconsistency is noted rather than resolved.

Stages at which delays occur

Delays at case detection or initial testing were recorded for all 50 respondents; this item did not vary and is reported as a facility-level account. Among items that varied, notification or reporting to the next level was identified by 23 respondents (46%), entry or recording of test results by 14 (28%), treatment initiation by 14 (28%), and patient follow-up by 11 (22%).

Table 5. Reported stages at which delays occur, by evidence class

Stage	n / 50	%	Evidence class
Notification or reporting to next level	23	46%	Individual
Entry or recording of test result	14	28%	Individual
Treatment initiation	14	28%	Individual
Patient follow-up	11	22%	Individual
Case detection or initial testing	—	—	Facility-level

Note: Multiple responses were permitted; percentages therefore do not sum to 100%.

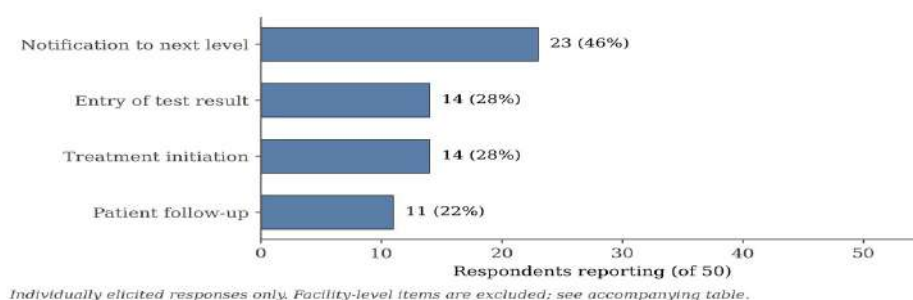


Figure 2. Stages at which delays were reported, individually elicited responses (n = 50)

Assessment of Hypothesis 1

The findings are consistent with the first hypothesis. IHIP was reported as present in the workflow by 98% of respondents, while point-of-care digital entry was reported by 2%. Connectivity, workload, staffing and training were reported as barriers at facility level, and duplicate entry, forwarding delays and unclear forms were identified by varying proportions of individual respondents. The hypothesis is supported as a description of this site; it is not evidence about facilities elsewhere.

Hypothesis 2: Perceived barriers to treatment

H2. Health workers will identify delayed diagnosis, late patient presentation, staff shortages and referral delays more frequently than medicine availability as barriers to timely malaria treatment.

Three treatment barriers were recorded for all 50 respondents: delayed diagnosis, late arrival of patients after symptom onset, and staff shortage. These items did not vary and are reported as a facility-level account. Among items that varied, delay in patient referral was selected by 25 respondents (50%) and inadequate patient follow-up by 4 (8%). No respondent identified drug stock-out as a barrier.

Table 6. Reported barriers to timely malaria treatment, by evidence class

Barrier	n / 50	%	Evidence class
Delay in patient referral	25	50%	Individual
Inadequate patient follow-up	4	8%	Individual
Delayed diagnosis	—	—	Facility-level
Late patient arrival after symptom onset	—	—	Facility-level
Staff shortage	—	—	Facility-level

Drug stock-out	—	—	Facility-level (not identified)
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Note: Multiple responses were permitted; percentages therefore do not sum to 100%.

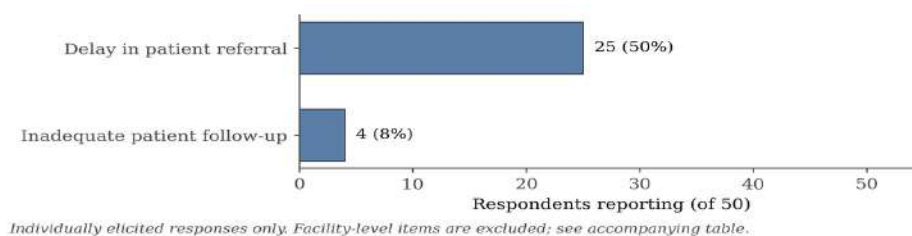


Figure 3. Treatment barriers, individually elicited responses (n = 50)

Assessment of Hypothesis 2

The findings support the second hypothesis. Delayed diagnosis, late patient presentation and staff shortage were reported at facility level as treatment barriers, and referral delay was identified by half of respondents, while no respondent identified drug stock-out. It should be noted that this reflects what respondents identified as barriers and does not constitute independent verification of medicine availability; no stock registers were examined. The finding is best stated as: no respondents identified drug stock-outs as a barrier to timely treatment at this facility.

The absence of any respondent-identified drug stock-out barrier, alongside the reported presence of diagnosis, presentation and staffing barriers, is a substantively useful result for programme purposes. It indicates that respondents perceived constraints in detection, care-seeking and human resources as more prominent than medicine availability. It does not establish that commodity supply was objectively adequate, since no stock registers were examined.

Reported perceptions of the digital system

All 50 respondents reported that the digital system helps reduce reporting delays, and all 50 identified time saving through internet-based reporting as what works well. All 50 identified electricity and internet connectivity failure as the principal practical difficulty. All 50 reported that both paper and digital systems are relied on equally in day-to-day work, and all 50 reported no perceived gap between how the reporting system is intended to work and how it works in practice. These items were recorded uniformly and are reported as a facility-level account.

The combination is worth stating carefully. At facility level, the digital platform is described as valued and as delay-reducing, while its principal reported difficulty is the

infrastructure it depends on, and paper and digital recording are described as operating together rather than one replacing the other. Respondents did not describe this arrangement as a departure from intended practice. Rather than a system perceived as failing, the account describes a hybrid workflow that staff regard as normal working practice.

Reported suggestions for improvement

Two free-text items asked what single change would most improve case reporting and treatment timeliness respectively. Both were recorded identically across all 50 records: mandatory and immediate reporting of all confirmed cases by private practitioners to government authorities, and sufficient manpower arrangement. As uniform records, these are reported as the facility-level position rather than as fifty independent suggestions. Both are consistent with the barrier data, and the emphasis on private-sector notification identifies a surveillance gap that is not otherwise visible from facility records.

Challenges

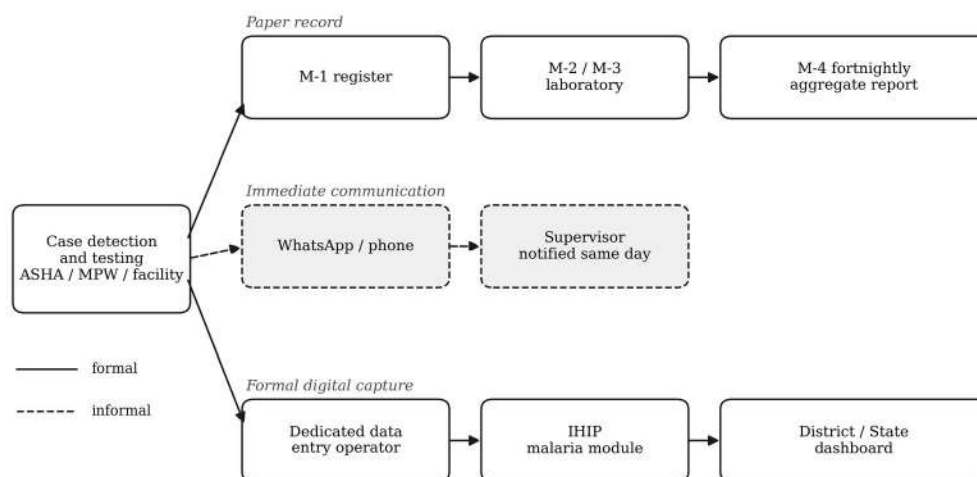


Figure 4. Malaria case reporting pathway as described by respondents, Khadkala PHC and associated sub-centres. Paper recording, immediate communication and formal digital capture operate as parallel pathways. Solid lines denote formal recording and reporting; dashed lines denote informal notification.

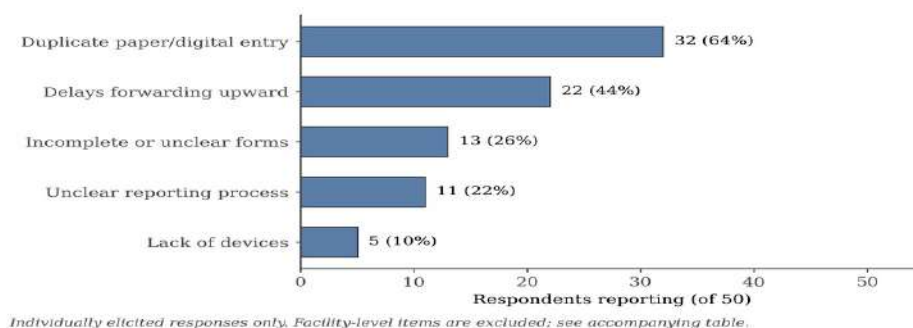


Figure 5. Data flow barriers, individually elicited responses (n = 50)

The barriers reported at the study site are not a list of separate problems but a set of interacting constraints. They can be organised using the PRISM framework, which analyses routine health information system performance in terms of technical, organisational and behavioural determinants rather than technical factors alone (Aqil, Lippeveld and Hozumi 2009). Each of the three domains is represented in the responses, and the interaction between them explains more than any single barrier taken alone.

Technical determinants

Internet connectivity was reported as a barrier at facility level by all respondents, and electricity and connectivity failure was identified as the principal practical difficulty with the digital system. This is the constraint that distinguishes digital from paper reporting in kind rather than degree: an M-1 register can be completed during a power cut, and IHIP cannot. Lack of devices was reported by only 5 respondents (10%), so hardware availability is not the limiting factor. The equipment is present; the conditions required to use it are intermittent.

Organisational determinants

Staff shortage and high workload were both reported at facility level, and staff shortage was reported as a barrier to timely treatment as well as to data flow. This is the constraint that shapes what gets deprioritised. Where a health worker is carrying a clinical caseload during a transmission peak, administrative tasks that produce no immediate benefit to the patient in front of them are the first to be deferred. Duplicate paper and digital entry compounds this directly: 32 respondents (64%) identified it as a barrier, and the tool data support that parallel recording occurs, since 98% reported both IHIP and all four M-series formats in use. Delays in forwarding information to higher

levels, reported by 22 respondents (44%), indicate that the constraint is not confined to the facility but extends into the administrative chain above it.

The structure of data entry is itself an organisational factor. All respondents reported that IHIP entry is performed by a dedicated data entry operator rather than by the staff who detect cases. This places a transfer step between detection and digital capture. Even under ideal connectivity, information must move from the person who identified the case to the person who records it, which is a structural interval that no amount of network improvement removes.

Behavioural determinants

The most striking finding in this domain is what respondents did not report. All 50 reported that the digital system helps reduce reporting delays, and all 50 reported no perceived gap between how the reporting system is intended to work and how it works in practice. On the face of it, the workflow described, in which paper recording occurs at the point of care, notification follows immediately by messaging, and formal digital entry is performed afterwards by an operator, is not reported as a departure from intended practice. This response was recorded uniformly across all records rather than elicited from each respondent independently, so it cannot support a claim about what individual staff believe. It is best read as a facility-level position, and normalisation of the hybrid workflow as one possible interpretation of it rather than a demonstrated mechanism.

This matters for how the situation should be interpreted and addressed. A workforce that regards its workflow as deficient can be expected to change it given the means. A workforce that regards its workflow as correct has less internal prompt to change it. Whether an external prompt exists at this site is not established by these data, since respondents were not asked whether the facility receives feedback on its reporting performance from the district surveillance unit. Nutley and Reynolds (2013) argue that improving the availability of health data achieves little unless the systems and incentives to act on it are also present; the same logic applies upstream, to the incentives to record it.

The interaction between domains

These three domains reinforce one another. Connectivity failure makes point-of-care entry impossible; the dedicated-operator arrangement and duplicate recording absorb the staff time that might otherwise close the gap; and because the resulting workflow is understood as normal, it is

stable rather than self-correcting. Removing any one constraint in isolation would be unlikely to change the outcome.

The findings are consistent with measured evidence from elsewhere in India. Patel et al. (2026) found that IHIP captured 44% of laboratory-tested malaria cases in Raigarh district, Chhattisgarh, and identified inadequate laboratory technician knowledge of IHIP data entry and poor district surveillance unit feedback as the root causes, both of which correspond to constraints reported at the present study site, where training gaps were reported at facility level. The Raigarh finding is significant here for a further reason: the deficit was closed to full sensitivity within five weeks through refresher training and a weekly district feedback mechanism. The barriers reported at Khadkala PHC are of the kind that have proved addressable with ordinary programme resources.

Future Implications

The findings of this study point toward a set of changes that follow directly from the constraints reported, rather than from general expectations about health technology. Each of the implications below addresses a barrier identified at the study site, and each has some basis in evidence from comparable Indian settings.

Offline-capable digital entry with automatic synchronisation

Where a workflow requires an active connection to accept an entry and connectivity is intermittent, real-time reporting is not achievable however well the platform is designed. WHO guidance advises implementers to assess network and electricity access before deployment and notes that systems may need to function without an internet connection where access is unreliable (WHO 2019). Offline entry with subsequent synchronisation is not a new capability in this context: the IHIP mobile application for presumptive and laboratory forms is documented as operating offline and transferring data to the server through a sync function. What these data do not establish is whether that capability is available and in use within the malaria reporting workflow at the study site, or whether a web-based workflow is used instead. Establishing this is the necessary first step; where offline capture is unavailable within the malaria workflow, extending it would address the constraint respondents identified as the principal practical difficulty.

Reduction of parallel recording requirements

The same WHO guidance warns specifically about arrangements in which health workers must maintain a new digital system in addition to existing paper systems, identifying the added workload as a risk to implementation (WHO 2019). At the study site, both IHIP and all four M-series formats were reported in use by 98% of respondents, and 64% identified duplicate paper and digital entry as a barrier. Where the same information is captured in both systems, there is scope to examine whether the paper requirement can be reduced or whether digital records can be accepted in place of specific paper returns. This is a question for programme authorities rather than for individual facilities, since the M-series formats are nationally specified and serve purposes beyond the facility that generated them, including stock position reporting.

Strengthening the feedback loop from district level

The Raigarh experience indicates that the relationship between reporting facilities and the district surveillance unit is a practical determinant of data capture, not merely an administrative formality. Patel et al. (2026) identified poor district feedback as one of two root causes of low reporting sensitivity, and a weekly feedback mechanism as part of the intervention that closed the gap. This bears on the behavioural finding at the present site, where respondents reported no perceived divergence between intended and actual practice. A facility that receives regular information on its own reporting performance has a basis for recognising a gap. Whether such feedback reaches the study site was not asked and is not known; the Raigarh experience indicates that it is worth establishing.

Measurement of what the system actually does

A limitation of this study is that it measures reported practice rather than system behaviour. That limitation also indicates a direction for further work. IHIP records the time of entry, and the M-series formats record dates of detection, dispatch, laboratory receipt, result return and treatment initiation. Comparing entry timestamps against these recorded dates at a facility would establish the actual interval between case detection and digital capture, which no questionnaire can determine. The M-4 format already requires reporting of the number of slides reported within 24 hours, so a timeliness indicator exists within the system as designed. Studies of this kind, in the manner of the register-against-platform comparisons conducted in Raigarh and across six Chhattisgarh districts, would test at Khadkala PHC what this study has only been able to describe.

Policy Recommendations

The recommendations below arise from exploratory evidence collected at a single primary health centre network and should be read as implications for consideration rather than as national policy prescriptions. Where possible, each is supported by evidence from comparable Indian settings or by existing national and international guidance. They are addressed to programme managers at district and state level, and to the National Center for Vector Borne Diseases Control where national specification is involved.

1. **Establish whether offline entry and synchronisation are available and operational within the malaria reporting workflow at the study site.** Internet connectivity was reported at facility level as a barrier to data flow, and electricity and connectivity failure as the principal practical difficulty with the digital system. Offline capture with subsequent synchronisation is already documented as a feature of the IHIP mobile application for presumptive and laboratory forms, so the question at facility level is whether that functionality is accessible and in use for malaria reporting, or whether a web-based workflow without it is being used. Where offline capture is unavailable within the malaria workflow, extending it would directly address the reported constraint. This is a platform and programme-level matter rather than one available to individual facilities.
2. **Review and rationalise duplicate reporting requirements, particularly where equivalent information is captured both digitally and on paper.** At the study site, 98% of respondents reported both IHIP and all four M-series formats in use, and 64% identified duplicate paper and digital entry as a barrier. WHO guidance identifies the requirement to maintain a digital system alongside existing paper systems as a recognised implementation risk (WHO 2019). A review at programme level could establish which M-series data elements are duplicated in IHIP and whether any paper returns can be reduced or replaced. This requires care rather than wholesale removal: the M-1 and M-4 formats carry stock position reporting and other functions that IHIP does not replicate, and the formats are nationally specified for purposes beyond the facility that completes them.
3. **Review whether routine feedback on reporting performance reaches the facility, and establish it where it does not.** In Raigarh district, Chhattisgarh, poor district

surveillance unit feedback was identified as one of two root causes of low malaria reporting sensitivity, and a weekly feedback mechanism formed part of the intervention that raised sensitivity from 44% to 100% within five weeks (Patel et al. 2026). At the present study site, respondents reported no perceived gap between intended and actual practice. Whether the facility receives routine feedback on its reporting performance was not asked, and establishing this would be a necessary first step. Feedback of this kind is a low-cost administrative measure with demonstrated effect in an Indian PHC setting, and a review of current practice would determine whether it is needed here.

4. **Conduct a workload and staffing assessment at facility level.** Staff shortage and high workload were reported at facility level as barriers to both data flow and timely treatment, and sufficient manpower was identified as the change that would most improve treatment timelines. These data record a perception and cannot establish what staffing a facility requires. A workload assessment covering clinical caseload alongside recording and reporting duties would convert that perception into a measured basis for any staffing decision, and would also establish how much staff time the current recording arrangements consume.
5. **Provide periodic refresher training on digital data entry rather than training only at deployment.** Training gaps were reported at facility level at the study site. Inadequate laboratory technician knowledge of IHIP data entry was the other root cause identified in Raigarh, where the remedy was refresher training for staff who had already been trained at rollout (Patel et al. 2026). Skills decay, staff change roles, and platforms are updated. Building periodic refresher input into the surveillance programme's routine schedule is a modest and costed measure.
6. **Strengthen and simplify private-sector malaria case notification, and enforce existing reporting requirements.** The change identified at facility level as the highest priority for improving case reporting was mandatory and immediate notification of confirmed cases by private practitioners. This corresponds to a documented national gap: India's malaria data are collated principally from the public health sector, while a substantial proportion of cases are diagnosed and treated privately and are never recorded (Rahi and Sharma 2022). Public-sector workflow improvements cannot capture cases the public sector never sees. Simplifying the notification pathway available to private

providers, and strengthening enforcement of existing obligations, is a district and state-level measure that addresses a gap facility staff identified but cannot themselves close.

A note on workforce

Staff shortage and high workload were reported at facility level as barriers to both data flow and timely treatment, and sufficient manpower was identified as the single change that would most improve treatment timelines. This report does not make a staffing recommendation, because establishing what level of staffing a facility requires demands workload measurement and human resource analysis that were outside the scope of this study. The finding is recorded as reported: at this site, health workers identified workforce capacity as the binding constraint on both reporting and treatment. Whether that assessment is borne out by measured workload is a question for a study designed to answer it.

Conclusion

This study set out to examine what barriers health workers identify in malaria case reporting and treatment, and how digital reporting is used alongside paper-based recording in daily practice. Fifty health workers at Khadkala Primary Health Centre and its associated sub-centres in Pune District were surveyed using a structured questionnaire. The findings describe one site during one transmission season, and are offered as such.

The reporting workflow described by respondents is a hybrid one. IHIP was reported as present in the facility's malaria reporting workflow by 98% of respondents, and the four M-series paper formats by the same proportion, with messaging applications reported by 96%. These are not competing alternatives at this site; they are reported as operating together. All respondents reported that confirmed cases are notified to the next administrative level on the same day, that cases are shared informally through messaging before formal digital entry, and that digital entry is performed by a dedicated data entry operator. Only one respondent reported that entry occurs in real time at the point of care.

These responses are consistent rather than contradictory. They describe case detection followed by immediate notification through an informal channel, with formal digital capture occurring subsequently and through a different person. The interval between the two cannot be determined from a questionnaire, and this study does not claim that IHIP fails to function in near-

real time. What it establishes is that notification and digital capture are distinct steps at this site, performed by different people through different channels, and that the paper record remains embedded in routine practice.

The barriers reported fall into three interacting domains. Technically, connectivity and electricity failure were the principal reported difficulty, while device availability was reported by only 10% of respondents. Organisationally, staff shortage and high workload were reported at facility level, duplicate entry by 64% and delays in forwarding information upward by 44%, indicating a constraint extending beyond the facility into the administrative chain. Behaviourally, all respondents reported that the digital system reduces delays and that there is no gap between intended and actual practice. The hybrid workflow is not experienced as a deviation but as normal working practice, which is why it is stable.

On treatment, respondents identified delayed diagnosis, late patient presentation and staff shortage at facility level, and referral delay by half of respondents. No respondent identified drug stock-out as a barrier. This locates the reported constraints on timely treatment in detection, care-seeking and workforce rather than in commodity supply, a distinction with direct programme relevance, since these require different responses.

These findings are qualified in the Methodology and Results, and those qualifications are not repeated here beyond the essential point: the study describes one purposively sampled facility network, reports what health workers said rather than what the system did, and distinguishes throughout between individually elicited responses and items recorded once at facility level.

The picture corresponds to measured evidence elsewhere in India. In Raigarh district, Chhattisgarh, IHIP captured 44% of laboratory-tested malaria cases, with inadequate knowledge of digital data entry and absent district feedback identified as root causes, and the deficit was closed within five weeks through refresher training and a weekly feedback mechanism. The constraints described here are of a kind that has proved addressable with ordinary programme resources.

India's objective of zero indigenous malaria cases by 2027, and elimination by 2030, depends on a surveillance system that detects, reports and responds to individual cases. The gap between an estimated national burden of roughly 3.4 million cases and a programme-reported total of 176,522 indicates how much of that work remains. This study suggests that at facility level the

limiting factors are not the availability of a digital platform, which respondents reported as present and valued, but the conditions under which it operates: connectivity, workload, parallel recording and training. Several of these operational constraints appear tractable.

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The author also thanks the health workers of Khadkala Primary Health Centre and its associated sub-centres, who gave their time during a period of peak seasonal caseload to respond to this questionnaire. The findings of this study rest entirely on their willingness to describe their working practice candidly.

Responsibility for the analysis, interpretation and any errors in this report rests with the author alone.

Appendix

Appendix A. Health Staff Questionnaire (Questionnaire B)

The instrument reproduced below was administered to 50 health workers at Khadkala Primary Health Centre and associated sub-centres. It comprises 23 items across five sections. The questionnaire was preceded by a consent statement and by fields for respondent identifier, date of interview, interviewer name and facility name.

Note: Response options for tick-all-that-apply items (Questions 3, 5, 11, 12 and 13) are reproduced as recorded in the response dataset. Options for single-select items are reproduced from the administered instrument. Items marked free text were open-response fields.

Question	Response options
Section A. Respondent profile	
1. What is your current designation?	Free text
2. How many years have you been in your current role?	Less than 1 year / 1–3 years / 4–6 years / More than 6 years
3. What is your main role in malaria-related work? (Tick all that apply)	Diagnosis or testing / Treatment and patient care / Data entry or reporting / Surveillance / Follow-up of cases / More than one of the above
Section B. Recording and reporting process	
4. How are malaria cases first recorded at this facility?	Paper register only / Digital system only / Both paper and digital
5. Which tools or formats are used here for malaria data recording or reporting? (Tick all that apply)	M1 form / M2 form / M3 form / M4 form / OPD register / Laboratory register / IDSP forms / IHIP / Email / WhatsApp or other messaging / Other (please specify)
6. To whom is confirmed malaria case data usually reported from this facility?	Immediate supervisor / Block level or Block Medical Officer / District level or District Health Office / Entered directly into digital system / Other (please specify)
7. How long does it typically take for a confirmed malaria case to be reported to the next administrative level?	Same day / Next day / 2–3 days / More than 3 days / Varies, no fixed timeline
8. Is malaria case data entered into a digital system in real time, at the point of care?	Yes, always / Sometimes / No, entry is delayed
9. In practice, which system is relied on more for day-to-day malaria work?	Paper-based system / Digital system / Both are used equally
10. Is the same malaria data entered or recorded more than once across different registers or systems?	Yes / No / Sometimes. If yes, free text on where duplication occurs
Section C. Delays and barriers	
11. At which stage do delays most commonly occur?	Case detection or initial testing / Entry or recording

(Tick all that apply)	of test result / Notification or reporting to higher level / Treatment initiation / Patient follow-up
12. What are the main barriers to timely malaria data flow at this facility? (Tick all that apply)	Internet connectivity issues / Lack of devices / Staff shortage / High workload / Incomplete or unclear forms / Unclear or inconsistent reporting process / Gaps in training on reporting tools / Duplicate paper and digital entry requirements / Delays in forwarding information to higher levels / Other (please specify)
13. What are the main barriers to timely malaria treatment at this facility? (Tick all that apply)	Delayed diagnosis / Drug stock-out / Delay in patient referral / Late arrival of patient after symptom onset / Staff shortage / Inadequate patient follow-up / Other (please specify)
14. Are malaria cases ever first recorded on paper and then shared informally through email or WhatsApp before formal digital entry?	Yes, regularly / Sometimes / No
15. Is there a gap between how the malaria reporting system is designed to work and how it works in practice at this facility?	Yes / No. If yes, free text description
Section D. Digital tools in practice	
16. Which digital platform or system is used here for malaria reporting?	Free text (platform name)
17. Who typically enters malaria data into the digital system at this facility?	Doctor or clinician / Laboratory technician / Dedicated data entry operator / Nurse or health worker / More than one person, depending on availability
18. What works well about the current digital reporting system?	Free text
19. What does not work well, or what are the main practical difficulties with the digital system?	Free text
20. In your experience, does the digital system help reduce reporting delays?	Yes, it reduces delays / Partly, it helps but delays still occur / No, delays remain the same or have increased
21. What still forces staff to rely on paper or manual methods, even when a digital system is available?	Free text
Section E. Suggestions	
22. What one change would most improve malaria case reporting at this facility?	Free text
23. What one change would most improve treatment timelines for malaria-positive patients?	Free text

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