

Better Tools to Identify Severe Disease in Children evaluation – Country case studies

Unitaid

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COUNTRY CASE STUDIES

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STRUCTURE OF THIS APPENDIX

This Appendix contains the five country case study reports conducted as part of the Unitaid “Better tools to identify severe disease in children” portfolio evaluation. These were Burkina Faso, Guinea and India (conducted as part of Phase 1 of the evaluation), and Kenya and Senegal (conducted in Phase 2).

PHASE 1 CASE STUDIES

Appendix A **BURKINA FASO CASE STUDY**

A.1. BACKGROUND AND CONTEXT FOR AIRE PROJECT

Key country characteristics

In recent years, the government of Burkina Faso has been making significant efforts to strengthen the national health system and increase access to health services for its population, resulting in a decrease in under 5 mortality over 2011 to 2019 (the starting year of the AIRE project) from 117 to 99 per 1000 live births.¹ These efforts included introducing a national exemption fee policy in 2016 to enable free access to healthcare at the point of care for pregnant and under-5 children at all healthcare levels, and partnering with Terre des Hommes and other partners² to develop and scale up an Integrated eDiagnosis Approach (leDA), including use of an Electronic Register of Consultations (REC) tool to improve clinical decision-making at PHC level for better diagnosis and treatment of sick children.³

Despite these efforts, the under 5 mortality in the country still remains considerably higher than the SDG target (25 per 1000 live births) and child mortality is mostly driven by preventable and treatable infectious diseases.⁴ Access to healthcare remains a challenge due to a lack of health facilities close to home⁵ and limited availability of treatment and diagnostic tools amongst other factors. The deteriorating security situation in Burkina Faso has compounded these challenges. In addition to growing numbers of internally displaced people (IDPs) (613,792 as of February 2020)⁶, the situation has resulted in the closure of 15% of national health facilities (265 out of 1,781, including in the AIRE project areas), depriving nearly 2.5 million people of access to health care in the country.⁷

AIRE project overview

Poor identification of severe diseases in children at PHC level due to a lack of appropriate diagnostic tools is a common issue in many LMICs including Burkina Faso. This leads to under-referral and poor management of critical cases of severely ill children which ultimately contributes to high levels of child mortality.

¹ World Bank (2023). Mortality rate, under-5 (per 1,000 live births) - Burkina Faso.

<https://data.worldbank.org/indicator/SH.DYN.MORT?locations=BF>. In 2021 this had further declined to 83 per 1000 live births.

² TdH (2023). Project summary: leDA – A digital solution to save children's lives. <https://www.tdh.org/en/projects/ieda>

³ The leDA-REC tool is a digitalized version of the WHO medical protocol (IMCI) with embedded data analytics functionality to enhance clinical decision making. It includes an electronic Clinical Decision Support System (eCDSS), a health information system to collect consultation data as well as supportive tools for HCWs such as training courses on IMCI, quality assurance coaching and supervision system. LSHTM (2018). Integrated eDiagnosis Approach (leDA) for the management of illness in under-five children at the primary health care level in Burkina Faso.

<https://www.childhealthtaskforce.org/sites/default/files/2019-01/leDA%20Trial%20Findings%20Report%20%28LSHTM%202018%29.pdf>

⁴ In 2019, the top 3 leading cause of under 5 deaths at PHC level in the country were severe malaria (27.4%), acute respiratory infections (12.7%) and non-bloody diarrhea (2.5%) and, at secondary healthcare level, severe malaria (13.0%), newborn infections (5.4%) and pneumonia (3.8%). MSHP (2020). Annuaire Statistique de la Sante 2020.

http://cns.bf/IMG/pdf/annuaire_statistique_ms_2020_signe.pdf

⁵ The average radius to a health facility in the country decreased from 6.5km² in 2017 to 6.2 km² in 2020 (MSHP 2020).), but remained higher than the WHO recommendation of 5km (Ashiagbor et al, 2020).

[https://www.sciencedirect.com/science/article/pii/S2468227620301915#:~:text=The%20World%20Health%20Organization%20\(WHO\)%20recommends%20that%20for%20optimal%20access,the%20measure%20investigated%20%5B24%5D](https://www.sciencedirect.com/science/article/pii/S2468227620301915#:~:text=The%20World%20Health%20Organization%20(WHO)%20recommends%20that%20for%20optimal%20access,the%20measure%20investigated%20%5B24%5D)

⁶ OCHA Burkina Faso Cluster santé. Snapshot.ai : aperçu de la situation 17 février 2020

⁷ OMS : Bulletin n°21 réponse sanitaire de l'OMS à la crise humanitaire au Burkina Faso (dec 22 - janv 23)

In Burkina Faso, the AIRE project was implemented in 87 operational PHCs, 2 district referral hospitals and 4 research sites (table A.1, figure A.1). The lead implementing partner was Terre des Hommes (TdH) and the lead research partner INSERM (Institut National de la Santé et de la Recherche Médicale). The project was implemented over July 2019 to December 2022, with no cost extension to April 2023.⁸

Table A.1: Description of AIRE intervention sites in the Boucle du Mouhoun region of Burkina Faso

Health districts	Boromo	Dedougou
# District hospital	1	1
District referral hospital	CMA de Boromo	CHR de Dedougou
# operational PHC	38	49
# research site	2	2
Name of research site	CSPS de Ouahabou CSPS de Oury	CSPS de Fakena CSPS de Bissanderou
Total population of the intervention area:	729 433 inhabitants	
Budget for Burkina Faso		

Figure A.1: Map of AIRE



intervention districts

The main AIRE activities were:

- Support to strengthen the health system in the two regions and districts project sites: capacity building of health care providers at the peripheral and hospital level, equipping peripheral health centers and hospitals for the screening and management of cases of hypoxemia as well as their supply with drugs and medical consumables for the treatment of children under 5 years of age, and periodic joint supervision;
- Capacity building of community health workers and support for community awareness-raising;
- Mobilization and advocacy with national authorities and other actors for the introduction of PO in IMCI and revision of the Ministry of Health’s normative documents to take PO into account;
- Production of reference documents to facilitate the scaling up of PO including a supply and management guide in PO and a costed operational plan for scaling up;
- AIRE study protocol implementation and dissemination of research results.

⁸ AIRE Burkina Faso budget was US\$634,346.18.

A.2. KEY FINDINGS

Relevance, Coherence

AIRE was highly relevant to public health needs in Burkina Faso, and government's interest in evidence to support decision-making.

- At the beginning of the project, POs were mostly confined to hospital level and not used in IMCI at PHC level, thus AIRE targeted a clear public health need.⁹ Available POs were also rarely adapted for use on infants and young children hence the need for appropriate tools adapted for this segment of the population.
- By focusing on PHCs, the project positioned itself well to identify severely ill children as early as possible and improve chances of better diagnostic and timely referral for appropriate care management.
- Coupling the project implementation with operational research to document evidence on the feasibility and effectiveness of PO introduction in the country was praised by national stakeholders who wanted contextual evidence to support decision making at national level.

The project demonstrated strong alignment with national priorities and ensured an effective integration of interventions in existing national systems.

- The project engaged national and subnational government officials proactively, from the onset and throughout implementation (e.g., strong involvement of national Direction de la Santé de la Famille (DSF), Secrétariat Général (SG), Direction Générale de la Santé et de l'Hygiène Publique (DGSHP) and its technical departments, regional (Direction Régionale de la Santé (DRS) Boucle du Mouhoun and Direction du Centre Hospitalier Régional (CHR) of Dedougou and provincial Médecin Chef du District (MCD) of Boromo and MCD of Dedougou health authorities). Feedback from health facility staff indicates strong collaboration with AIRE.
- National government feedback and recommendations were considered in the design and implementation of the project to strengthen its relevance and coherence with existing interventions and needs. For example, Ministry of Health and Public Hygiene (MSHP) leadership staff were involved during facility assessments. Staff from the Direction de la Santé de la Famille (DSF) unit also participated in integrated supervision training.
- In addition, IMCI training and clinical supervision were integrated in MSHP existing processes, and the project used the existing referral system to follow up on severely ill children being referred to hospitals for secondary care.
- In addition to providing training and equipment at PHC level, AIRE also provided equipment (e.g., oxygen extractors and cylinders, nebulizers etc.) to referral hospitals to support appropriate treatment of children being referred from project facilities.

The project also benefited highly from the existing credibility and trust of its implementing partners in the country, and built on previous successful interventions.

- The project interventions were highly complementary with ongoing national efforts for PHC strengthening and built on the Integrated eDiagnostic Approach (leDA) Electronic Register of Consultations (REC) tool being scaled up in country (62% coverage by 2020).¹⁰ For AIRE, the REC/IMCI tool was adapted to enter SpO₂ results, include guidance on SpO₂ measurement and clinical responses to SpO₂ readings. PHC staff familiarity with the leDA-REC tool thus also supported acceptability of PO use within IMCI consultations.

⁹ Ministère de la santé, Burkina Faso : Liste nationale des médicaments essentiels et autres produits de santé, éd 2020, 84p

¹⁰ <http://ieda-project.org/>

- Feedback from government officials suggested that the reputation of Terre des Hommes (TdH), who led the successful leDA-REC pilot and scale-up in partnership with the government, increased their trust, confidence and buy-in into the AIRE project.

The project engaged a diverse range national stakeholders including community representatives and civil society to be increase relevance and coherence with community interventions

- In addition to civil society organizations, community leaders as well as local researchers and the scientific community (societies of Pediatrics, Gynecology-Obstetrics, pulmonology etc.), the project engagement of traditional healers in community sensitization activities was highly relevant in response to traditional healers' influence on care seeking behavior in Burkina Faso.¹¹
- AIRE also engaged and leveraged the capacity of existing community health workers (*Agents de santé à base communautaire* (ASBC)) and CSOs, and benefiting from their trusted reputation and knowledge of communities to enhance awareness-raising activities and acceptance of PO by communities:
 - ASBC communication materials (e.g. posters) were revised to reflect information on dangers signs related to severe diseases and the benefit of using PO to enhance diagnosis;
 - ASBCs were trained on community mobilization.
 - AIRE provided ASBCs with a community communication guide and a one-off financial allowance to cover related costs.
 - CSOs were engaged in sensitizing communities in the districts and surrounding project sites on the acceptance of PO during IMCI consultations. CSO members participated in training sessions on PO, identification of danger signs and referral with other community leaders, in working meetings with the project teams and TdH, and in workshops for the dissemination of project results. They also have been provided with a community communication guide.
- CSOs did not receive any financing support from the project for their activities (as was done for ASBCs). The project was able to benefit from UNICEF existing financial support to CSOs and integrate PO advocacy materials withing wider advocacy activities.
- The project also produced and broadcasted radio spots in 3 local languages to reach more community members and complement ASBC activities.

The project adapted well to contextual changes including COVID-19, though less evidence on adaptations to stock outs connected to the national user-fee exemption

- The project implementation was significantly disrupted by the COVID-19 pandemic, including by delaying site assessments and restricting access to communities and stakeholders for engagement. Reprogramming was done in Q4 2020 including various changes to the initial project plan (such as reducing the scope of the research by removing the impact analysis and cost-effectiveness components) to ensure the project could be completed within budget and with minimal changes to the planned duration.¹² Other changes included reducing the time allocated for advocacy and community outreach activities. Additional support through Unitaid allowed AIRE to support the national Covid-19 response.
- AIRE was implemented during a period when the policy of exemption of user fees for healthcare for pregnant women and children under 5 was under pressure and stock outs were common. There was limited evidence that AIRE procurement quantification and forecasting reflected the (foreseeable) risk that facilities would use

¹¹ Do et al 2020. Patterns of healthcare seeking among people reporting chronic conditions in rural sub-Saharan Africa: findings from a population-based study in Burkina Faso. <https://onlinelibrary.wiley.com/doi/full/10.1111/tmi.13500>

¹² ALIMA (2021), AIRE annual report and GBO

the project resources to cover gaps in their procurement when necessary. As a result, the project had frequent stock outs of medications such as antibiotics because the project medications had to be used by the facility when they had procurement delays.

- Additionally, eight (8) health facilities and hospitals have also been closed in the project areas due to growing insecurities.¹³ Although no project facility was directly concerned, data from Boroma referral hospital showed that patients reoriented themselves to other health centers in the area and in neighboring districts potentially including project facilities. However, there was limited information regarding the impact of these events on the project as well as limited evidence of actions implemented to adapt to these challenges and mitigate any impact, e.g., potential increase in patient flow and higher demand of services compared to normal due to additional patients.

Efficiency

The project was delayed from July 2019 to January 2021, mainly due to the COVID-19 pandemic, but also due to additional delays in the design of the project research protocol, which have impacted dissemination of study results.

- The AIRE study was significantly delayed due to changes to the protocol to ensure the feasibility of the research, considering the time and budget constraints. The research protocol was approved in March 2021 and the research started in Q2 2021 (from an initial start date planned for Q2 2020)¹⁴. The overall project timeline was also extended to April 2023 to provide additional time for the research completion and results dissemination.
- Although the project managed to effectively start all its interventions in 2021, the project timeframe still remained shorter than originally planned. Despite the additional no-cost extension, the time allocated for advocacy activities and knowledge dissemination was significantly reduced and stakeholders feedback suggested that the remaining timeframe was too short to ensure their effectiveness given the need for scientific evidence for advocacy.
- Despite the project delay, some staff contracts were not adjusted to reflect the need for more time to implement activities under their responsibilities. As a result, key staff including the advocacy manager, the supply chain manager, research monitor, and research assistant, had to leave before the end of the project whilst activities were not completed.

Effectiveness and Impact

The project led to significant progress in the policy landscape to facilitate increased demand and adoption of pulse oximetry in Burkina Faso, and early indication of spillover into observer countries.

According to stakeholder feedback, the project significantly contributed to strengthening national policies and embed pulse oximetry in relevant guidelines and national plans. Specifically:

- The Ministry of Health and Public Hygiene (MSHP) revised the IMCI-REC protocol (in consultation with the Electronic Register of Consultations (REC)¹⁵ technical committee and scientific societies) to include the

¹³ Burkina Faso. Health sector. Bulletin- March 2022

¹⁴ ALIMA (2020). AIRE 2019 and 2020 GPU_GBO

¹⁵ As part of the Integrated eDiagnostic Approach, Terre des hommes partnered with Dimagi to create a tablet-based application known as the Electronic Register of Consultations (REC). The REC aims to increase nurses' adherence to IMCI protocols and improve their quality of care by providing enhanced decision support and case management capacity.

measurement of oxygen saturation SpO₂ using PO for under 5 children presenting with respiratory problems.^{16,17}

- The government also developed a procurement guide¹⁸ to support national supply chain actors and technical and financial partners for the procurement, distribution and use of pulse oximeters. This guide defines the technical specifications for POs adapted for PHC level and guidance for use on adults, children and newborns.
- The MSHP also revised the national public health facilities norms and standards of infrastructure and equipment document in July 2022, recommending the inclusion of PO at PHC level in alignment with the national list of essential drugs and other health products (LNME).¹⁹
 - This revision also recommends the procurement and distribution of PO and accessories through the Centrale d'Achat des Médicaments Essentiels Génériques et des consommables médicaux (CAMEG) to enable PO to be available in district pharmacies and through other vetted wholesalers' places for easier access. Thus, each district will be able to obtain it when necessary, with its own partial cost recovery funds managed locally by the management committees.
- The IMCI tools integrating the use of PO in algorithms for children under 5 were validated on March 10, 2023 through workshops.^{20,21} This includes IMCI chart booklet, IMCI-REC training tools, various IMCI-REC reporting and monitoring tools and IMCI training modules.
- SpO₂ measurement was observed to have been added to patient reference sheets in Boromo district to facilitate timely efficient care at referral level.
- Interviewees also suggested that the projects enable a spillover effect in observer countries. For example, Chad focal points had requested additional information on the Burkina Faso experience to share in their country during the global forum on pneumonia.

The project demonstrated high acceptability and adoption of PO in project facilities and use of PO in IMCI consultations identified an additional 6% of severely ill children. Further, the government has recently modified SpO₂ threshold for children with co-morbidities.

- According to HCWs interviewed, the project increased their awareness of the benefits of PO at PHC level, and significantly increased their capacity to better diagnose hypoxemia and triage children appropriately.
- HCWs also commented that they found the tool easy to use most of the time although it could be more difficult to use and take more time when the child is restless, which is not convenient especially during high workload periods such as malaria peak seasons.

"[Having pulse oximeters] fills a critical need. Without it we would never be able to measure children's oxygen saturation accurately on the periphery here, that at least is clear". (Healthcare worker, Burkina Faso).

¹⁶ Mémorandum sur l'intégration de l'OP dans les algorithmes PCIME du Burkina Faso 23/12/2022

¹⁷ Atelier de validation des outils de la PCIME-REC intégrant l'utilisation de l'OP au Burkina Faso 10/03/2023

¹⁸ Guide national d'approvisionnement en oxymètres de pouls. Septembre 2022.

¹⁹ Ministère de la santé et de l'hygiène publique, Burkina Faso : Normes et standards en infrastructures et équipements, éd 2022, 112p

²⁰ Burkina Faso. MSHP. Rapport de l'atelier de revue des outils de la PCIME intégrant l'utilisation de l'OP. Koudougou 20-24 février 2023

²¹ Burkina Faso. MSHP. Rapport de l'atelier de validation des outils de la PCIME intégrant l'utilisation de l'OP. Mars 2023

"Really there are no difficulties in using the Pulse Oximeter. Since once it is well charged, here is the device itself has no problem for use, its interpretation is not as complicated than that". (Healthcare worker, Burkina Faso).

"The PO I think that first of all it even informs us, it helps us to make decisions here because once you see that the saturation is good it allows you to be confident about the state of health of the child, on his care". (Healthcare worker, Burkina Faso)²².

- Of the 250,035 IMCI consultations recorded between June 2021 and December 2022 in Burkina Faso project sites, 182,404 were eligible for SpO₂ measurement and SpO₂ utilization rate among eligible children was 88.3 %. Of these, 4.1% of serious cases (IMCI+PO) were diagnosed. The estimated added value of using IMCI+OP for the identification of severe cases in the operational sites of the AIRE project in Burkina Faso was 6%. [5.5-6.6] 95%CI²³.
- The government has also recently decided to raise the oxygen saturation threshold from 90% to 95% for specific cases²⁴ to appropriate treatment and referral of complex cases that may present with moderate hypoxemia.

Community awareness activities were effective to encourage better care seeking behaviors

- Feedback from facility staff suggested that the project awareness raising activities (including through ASBCs) effectively encouraged caretakers to seek healthcare on time and led to easier acceptance of PO during consultations.

The AIRE research study also demonstrated high acceptability and demand for PO by caregivers although some caregivers may have been deterred by the lengthy study enrolment process.

- Health care providers consulted shared that parents and caregivers attending the facilities were very accepting of PO and often demanded it to be used on their children when they were informed of the project interventions.
- However, the length of the enrolment process in the study, which could last up to 45 minutes, deterred some mothers of hypoxemic children from participating. It is also unclear how the 45 minutes of enrolment time in the project study was accounted and mitigated to avoid additional delay in the referral of hypoxemic children for further treatment.

AIRE was also considered by stakeholders to have spill-over benefits beyond IMCI in project sites and strengthening the referral system

- According to health facility staff, the drugs and equipment procured for the project benefited the health facilities at large, especially to cover gaps in procurement for prenatal and MNCH care during stock out periods and ensure the continuity of essential services. They also suggested that the training²⁵ and supervision provided through the project strengthened clinical capacity and quality of care overall in the project facilities beyond IMCI. Other benefits highlighted by the central level teams interviewed included: provision of Infection Prevention and Control (IPC) for COVID-19 kits to both districts, financial support for the maintenance of 4 ambulances in the project area to strengthen the referral system, and training of 104 pharmaceutical depot sellers at PHC level (48 from Boromo and 56 from Dedougou districts) on inventory management techniques.

²² Feedback from HCW confirmed in interviews with Boromo district health providers. Specific quotes extracted from AIRE. Rapport des résultats de la recherche AIRE, version du 12 juin 2023

²³ AIRE. Rapport des résultats de la recherche AIRE, version du 12 juin 2023

²⁴ Updated for specific conditions such as in presence of co-morbidity (e.g., severe anemia (low Hb level < 6 g/dl) frequent in West African children) which may increase mortality risk even when children only present with moderate hypoxemia.

²⁵ Training included IMCI refresher training and training of biomedical staff on PO maintenance

AIRE advocacy was highly effective to influence stakeholders, however implementation delays and subsequent time constraints highly impacted its delivery especially for the dissemination of research results.

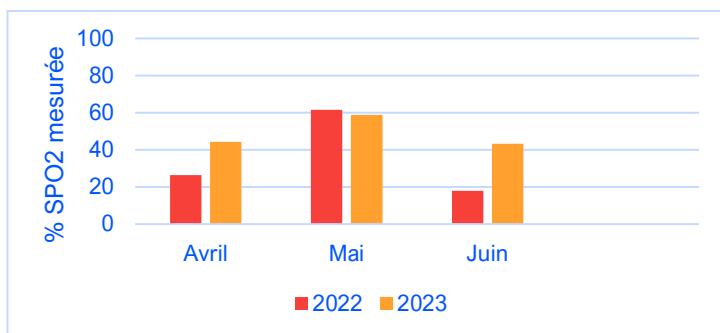
- Dissemination activities engaged a wide range of stakeholders including administrative authorities of the study areas, health districts and regional staff, scientific societies, civil society, community leaders, potential donors, and community representatives, to raise awareness on the benefits of using PO in IMCI at PHC level and inform key and inform policy change. Relevant MSHP staff including project managers and focal points also attended scientific congresses and forums (Madrid, Dakar, Journées des sciences de la Santé de Bobo Dioulasso) where AIRE results were presented.
- The project advocacy strategy consisted of proactively engaging national stakeholders through different communication platforms and tools), as well as discuss results and implication with stakeholders etc. The ongoing project advocacy throughout the implementation was highly effective to influence national stakeholders and increase political commitment. Feedback from government officials confirmed that it tangibly contributed to accelerating decision-making at national level to strengthen PO integration in policies.
- Regarding knowledge dissemination on the research results however, stakeholders and project staff suggested that the time allocated was short as research results were only available in December 2022 leaving just a few months before the end of the project in April 2023.

Sustainability and Scalability

There are positive indications that PO use has continued in project facilities, though it was reported there are gaps in supervision visits due to financial and logistic constraints.

- Data from the district reference center in Boromo²⁶ and confirmed in stakeholder interviews provides evidence that PO continue to be routinely used in the Boromo and Dedougou districts beyond the end of the project (Figure A.2).

Figure A.2: Proportion of children referred to the pediatrics department of the Boromo CMA with SpO₂ measured at PHC before referral during and at the end of the project²⁷



- Clinical supervision continues to include checking for IMCI+PO and oxygen therapy although this has not happened consistently since the end of the project. Supervisions planned to begin in May 2023 in the district of Boromo have not yet been completed across the 47 facilities due to lack of resources and logistical support.

²⁶ MSHP Burkina Faso. Rapports mensuels d'activités et des unités de soins et techniques du CMA de Boromo Avril 2022 – juin 2023

²⁷ Source: Boromo health statistics as communicated during in-person interview.

- The project was able to train 6 biomedical technicians (3 at Boromo district and 3 at Dedougou district) in medical equipment maintenance and establish a stock of POs spare parts made available to both districts for maintenance when needed. Preventive maintenance of POs is done by trained health care staff, while on-demand curative maintenance is carried out by trained biomedical technicians from the health districts.

Financing for national scale and sustainability is a key gap, though PO have been included in the Global Fund C19RM funding request.

- A 2023-2025 scaling up plan for the introduction of PO in IMCI in Burkina Faso have been developed by the government with cost estimations for its roll out. However, there was no evidence of allocated government budget to fund this plan or evidence of other financing arrangements.
- The government has included PO procurement as part of its funding request through the Global Fund COVID19 Response Mechanism (C19RM) ongoing application. To ensure POs are directed to PHCs and are also appropriate for children, it will be important to monitor how C19RM funds are directed.
- SpO₂ readings have been integrated into the existing country leDA-REC which makes it easier to be adopted and scaled up at national level. However, there is limited evidence of allocated funds to support scale out or dedicated resources for training and roll out activities.

Community awareness activities were effective to encourage better care seeking behaviors from caretakers but it is unclear how these outreach activities will be sustained beyond the project.

- Feedback from facilities staff suggested that the project awareness raising activities (including through ASBCs) effectively encouraged caretakers to seek healthcare on time and led to easier acceptance of PO during consultations. However, the continuation of community outreach activities is unsure because of existing challenging beyond the project. The ASBCs interviewed shared they were often demotivated due to recurrent delays from the government in paying their financial allowances for remuneration and to cover their costs. In addition, they flagged competing priorities especially during growing season when they have to take care of their fields.
- CSOs were also involved in awareness-raising activities at district level and outside the project intervention area. CSOs engagement was streamlined as part of ongoing advocacy activities funded by UNICEF. However, it is unclear how this will be sustained beyond project closure.

The project highlighted the importance of embedding interventions for PO introduction and scale up in a wider strategy for strengthening oxygen systems and health systems

- Stakeholders noted that although using pulse oximeters to diagnose children is highly beneficial, it is only a first step towards enabling appropriate and timely treatment for children which is the main overarching goal. They highlighted the importance of investing in strong oxygen systems that integrates the adoption and scale up of PO. For example, at referral hospital level, oxygen cylinders (provided through the project) had to be moved from one patient bed to the other as facilities did not have a wall-mounted O₂ system to dispense oxygen in a safer way. In addition, staff identified they sometimes had low capacity to supervise oxygen therapy, presenting additional safety and security risk for using oxygen both for patients and facilities.
- Government and global partners efforts have been aligned with this approach and PO introduction has been done in parallel with interventions to strengthen the procurement and safe use of oxygen. For example, the Directorate General in charge of access to health products (DGAP) has shared its plan to conduct an assessment of oxygen needs in neonatology units across the country by the end of the year 2023 following a request from the MSHP. Terre des Hommes and various partners also supported the MSHP to create an oxygen user guide “guide d'utilisation de l'oxygène” to support safe use of oxygen on children in the country.
- Health workers have also reported difficulties transferring hypoxemic children to reference centers due to lack of oxygen in the ambulances and unsuitable means of transportation. The results shared at the project closing

ceremony mentioned that 100% of the 10 cases of severe hypoxemia in Burkina Faso were referred to hospital, and only 60% of them received oxygen.

“The positive effect of using PO to reduce infant mortality in CSPSs will be lost if children diagnosed with severe hypoxemia cannot be quickly transferred to a hospital, or if oxygen is not available there” (HCP feedback).

A.3. LESSONS LEARNED AND OPPORTUNITIES

- **The project’s overall success in Burkina Faso can be attributed to several factors, including working with an existing government partner (TdH), highly engaging the government and country stakeholders and integrating the intervention in existing health and procurement systems. It was also a unique case in that introduction of PO within IMCI was in the context of Burkina Faso’s existing e-IMCI system, which is not easily replicated.** AIRE highly benefited from the strong engagement of national stakeholders and political commitment from health authorities. This helped accelerate policy change and reforms for introduction of PO. The already digitized IMCI platform in use across all project sites (also supported by TdH in project areas) was also a favorable environment in which to introduce a complementary intervention.
 - It is also understood among country stakeholders that PO introduction at PHC level is a good first step to strengthen diagnostic capacity. However, the use of PO in itself cannot lead to reduced child mortality unless followed by appropriate treatment, highlighting the need for better oxygen availability and strengthened oxygen systems more widely.
- **There is an opportunity for international partners to align future investments and interventions with the new 2023-2025 action plan for scaling up PO in the country, though financing remains a major challenge.** The sustainability and scalability of pulse oximetry at PHC level will require strong political commitment from national and external stakeholders to ensure sustainable financing.
 - Future advocacy should include targeted advocacy to budget holders at district and national level to mobilise available domestic resources for PO and to ensure PO procurement is prioritized adequately in international funding requests.
 - Additionally, advocacy could target the district level where available unrestricted funding could be used without necessarily waiting for national budget or external funding.
 - Sustainability and scalability plans should also include opportunities to leverage existing partner interventions to sustain project interventions (e.g., include PO procurement in Global Fund and other partners funding requests), or as part of health systems strengthening efforts in ongoing projects such as the current African Development Bank HSS project in the boucle du Mouhoun region.²⁸
- **Overall, AIRE study dissemination was considered too short and the studies have also identified key topics where further analysis and evidence could support evidence based decision making.**
 - Continued dissemination of study results was considered important by stakeholders.
 - The project did not follow up on referred children who did not survive to identify causes of death, which stakeholders thought was a missed opportunity to integrate findings and learnings in PHC and hospital care interventions. Future research efforts should consider adding this.

²⁸ Projet de Renforcement des Services de Santé, funded by the African Development Bank

- **AIRE also highlighted the need for future investments to support health system strengthening efforts more widely including, but not limited, to:**
 - Developing national oxygen systems in alignment with a clear national medical oxygen access strategy;
 - Strengthening referral systems to ensure children diagnosed at PHC level receive appropriate care;
 - Improving health facility capacity for differential diagnosis to determine real causes of diseases and provided appropriate treatment beyond oxygen therapy.

A.4. LIST OF STAKEHOLDERS INTERVIEWED

Table A.2: List of country level stakeholder consultees for Burkina Faso

Organisation	Name	Position
Grantees/Sub-grantees		
Terre des Hommes	Sylvain TOE	Coordinator Santé
Terre des Hommes	Adama HEMA	Chef de projet AIRE
Government		
CSPS de Ouahabou	Boukaré OUEDRAOGO	IDE/ Dispensaire
CSPS de Ouahabou	Yvette W.A. ZONGO	SFE/ Maternité
CSPS de Ouahabou	Adelaïde P.M. COMPAORE	AB/ Maternité
CSPS de Ouahabou	Cendrine NARE	SFE/ Maternité
District Sanitaire de Boromo : Equipe Cadre du District	Laisitiré DABIRE	CSIO et Coach
CMA Boromo	David MILLOGO	Surveillant d'Unité de Soins
CMA Boromo Pédiatrie	Diane F. BARRY	Médecin Généraliste
MSHP Direction de la Santé de la Famille DSF	Moussa KINDA	Point focal AIRE
Civil Society Organization		
Communauté: ASBC	Mahamadou DERBO	ASBC du CSPS de Ouahabou
Communauté: ASBC	Blamani KONE	ASBC du CSPS de Ouahabou
Technical Partner		
UNICEF	Fatoumata TONI SANOU	Section Santé. Pédiatre-Spécialiste Santé Maternelle et Néonatale

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Appendix B **GUINEA CASE STUDY**

B.1. BACKGROUND AND CONTEXT FOR AIRE PROJECT

Key country characteristics

At the start of the AIRE project, child mortality was high in Guinea, at 104 per 1000 live births (higher than the SDG target (25 per 1000 live births), caused by malaria (27%), neonatal causes (28%), pneumonia or acute respiratory infection (12%), diarrheal diseases (0.9%), and HIV/AIDS (1%).²⁹ Malnutrition was a contributor to more than half of deaths of children under 5. Malaria rapid diagnostic tests were available and recommended at health facilities. Pulse oximeters (PO) were available and used in some units of public hospitals, but not in IMCI at PHC level.

Overall, access to healthcare remains a challenge due to insufficient quality and quantity of human resources, limited availability of treatment and diagnostic tools, and significant financial barriers.³⁰ According to the 2014-2016 National Health Accounts, households are the leading source of financing healthcare expenditure through direct payment, with 46.4% of expenditure, followed by donors with 35.7%. Government remains the third main source of funding with a contribution of 15.1%. This situation presents a great financial risk for households.

Despite the efforts made by the Guinean government to boost the health system since the Ebola epidemic in 2013, some dysfunctions persist, including difficult access to care by vulnerable populations and overall challenges in health service delivery. Guinea also experienced a coup in 2021 which impacted development efforts in country.

AIRE project overview in Guinea

The AIRE project aims to reduce mortality in children under 5 by introducing pulse oximetry into the IMCI (Integrated Management of Childhood Illness) consultation at primary health centers. The objectives are to increase the use and demand for pulse oximetry at PHC level through: 1) equipment resourcing and capacity building; 2) in-country advocacy for policy/systems strengthening and community sensitization; and 3) feasibility, impact and cost-effectiveness evidence generation.

In Guinea, the project was implemented in 31 operational PHC, 2 district referral hospitals and 4 research sites (table B.1 and figure B.1). The lead implementing partner was ALIMA (The Alliance for International Medical Action) and the lead research partner INSERM (Institut National de la Santé et de la Recherche Médicale).

Key project activities included:

- Support to strengthen the health system in project districts: capacity building of health care providers at the peripheral and hospital level, equipping peripheral health centres and hospitals for the screening and management of cases of hypoxemia as well as their supply with drugs and medical consumables for the treatment of children under 5 years of age, and periodic joint supervision;
- Developing a technical note with guidelines for integrating the pulse oximeter into integrated management of child and newborn illnesses (IMNCI);
- Developing an algorithm for guiding health providers on how to use the PO during primary curative consultations in children under 5 years of age;
- Revision of MoH documents to serve as a basis for the revision of the IMCI documents in the near future;

²⁹ WHO (2022). Child mortality (under 5 years). <https://www.who.int/news-room/fact-sheets/detail/levels-and-trends-in-child-under-5-mortality-in-2020#:~:text=There%20are%20two%20targets%3A,live%20births%20in%20every%20country.>

³⁰ Ministère de la Santé- République de Guinée. Annuaire statistique 2018 du Ministère de la Santé

- Conducting and disseminating research results;
- Capacity building of community health workers (CHW) and civil society organizations (CSOs) and support to CHWs for community awareness-raising.

Table B.1: Description of AIRE intervention sites in Guinea

Health districts	Matoto	Telimele
# District hospital	1	1
# operational PHC	16	15
# research sites	0	4

Figure B.1: Map of AIRE intervention districts



B.2. KEY FINDINGS

Relevance, Coherence

Overall, AIRE was relevant to public health needs and aligned with existing government structures for implementation. The project interventions also had a strengthening effect.

- The use of pulse oximeters (POs) to improve identification of severely ill children aligned with the leading causes of child mortality in Guinea, including pneumonia.³¹
 - An important difference in Guinea within the AIRE project countries that the **classification of ‘severe’ illness in the IMCI algorithm is more sensitive in Guinea**, as children presenting with chest indrawing are classified as ‘severe’ according to Guinea’s IMCI protocol (this is classified as ‘moderate’ in the other 3 AIRE countries).
- Feedback confirmed AIRE proactively engaged with the government from project onset and throughout implementation, e.g. good involvement of the National Director of Family Health and Nutrition in training, participation of the MoH central and district level staff in joint supervisions etc.
- For the most part, project interventions were well aligned and integrated in existing systems. E.g., project training and supervision were integrated in MoH processes, the project built on existing referral system to follow up on severely ill children being referred to hospitals for secondary care, and training and equipment were provided at both PHC and referral hospitals. AIRE data, (e.g. use of PO/ SpO2 measurement), were not integrated into the national data collection system. The project design also did not always reflect the varying design of participating health centres where for instance some CSPs (PHCs) have several consultation rooms, especially in Conakry/Matoto, but had only received one PO.

³¹ AIRE.Rapport_résultats de la recherche VF du 12 06 2023

AIRE engaged community and other civil society stakeholders to generate community demand and raise awareness on the value of PO during IMCI consultations at national level.

- The project engaged and leveraged the capacity of existing community health workers (*Agents de santé communautaire (ASC)/mobilisateurs sociaux*) and CSOs benefiting from the trust and knowledge of communities to enhance the effectiveness of awareness-raising activities and increase acceptance of PO by communities.
- Interviewees confirmed ASC were trained using updated communication tools which integrated POs³² and were incentivized to conduct awareness raising activities for care seeking to health facilities in response to danger signs for sick children and to increase PO acceptance by caregivers during IMCI consultations.
- In Guinea, the project worked closely with the National Coalition of Civil Society Organizations for the Promotion of Reproductive Health and the Repositioning of Family Planning to develop a specific advocacy plan for civil society. Civil society actors were invited to participate in the implementation of project activities but did not receive funding from the AIRE project to conduct activities on their own. They have been involved in advocacy for PO adoption and resource mobilization, according to the stakeholder engagement plan developed by the project team.

The project benefited from Covid-19 strengthening of oxygen systems.

- Covid-19 responses were regarded as helping to strengthen oxygen systems across the country and increased referral hospital capacity to provide adequate care for hypoxemic children referred.
- An oxygen project was launched by the government to include oxygen canisters for transportation of referred patients. The PSA plant at Conakry's Ignace Deen hospital was also refurbished and made operational, in addition to the oxygen supply to 6 health facilities in the Telimene district and Hopital Enta Nord of Matoto.³³

Effectiveness and Impact

AIRE positively contributed to operational readiness to integrate PO within the IMCI algorithm in Guinea. Within project areas, implementation was viewed as generally working well, with some areas for improvement noted.

- AIRE developed training tools to guide health providers on using PO during IMCI consultations in children under 5 years and made them available to project health centres.
- The introduction of PO in the IMCI algorithm followed by the training of providers was an opportunity to update provider knowledge of IMCI and socialize providers on the benefits of PO. This was viewed as well done in light of the high staff turnover at their posts as well as overall availability of POs in health centres. The duration of initial IMCI+PO training for PHC staff in the two pilot districts was shortened to 8 days per session, compared with the standard 21-day training period in Guinea. The shortened training thus had less focus on infants and newborns < 2 months.
- Stakeholders interviewed confirmed the acceptance of PO by providers but noted however the difficulties to use POs during surge periods (malaria peak season) and when the child is restless. Project documents report overall acceptability by users of PO at PHC in Guinea rose from 33.3% to 55.5% post-training.³⁴

³² This includes 300 ASC from 38 neighborhoods in the Matoto district were trained and equipped with posters.

³³ Information whether this was through Unitaïd support, or other Covid-19 response was not available during the case study.

³⁴ AIRE. Rapport des résultats recherche AIRE

What worked less well

- The project trained district maintenance technicians and recommended that district managers involve them in supervision and organize maintenance outings. Still, user maintenance of biomedical equipment, including POs, was not regularly carried out by health workers, and maintenance records were not completed according to project reporting.³⁵
- AIRE trained 813 ASC on identification of danger signs to support careseeking in the community for children under-5, however according to project reports, ASC activities were not effective. Stakeholder interviews identified lack of incentives / financing as a reason for this (see sustainability section).
- Delays in the project research contributed to a short time for dissemination of research evidence, with some analysis not yet validated and discussed with country stakeholders (refer to sustainability section).
- The 2021 military coup had a destabilizing effect on the country. Further, changes to Ministry of Health leadership resulted in turnover in AIRE counterparts, contributing to project delays.

The project had spillover effects in health systems strengthening:

- AIRE interventions also provided valuable additional benefits to project facilities beyond the project itself:
 - Staff training and supervision strengthened clinical oversight and capacity for better care provision in these facilities;
 - AIRE established a pool of experienced national IMCI/PO trainers, including pediatricians and IMCI/PO training sessions were carried out almost entirely by the national trainers, with ALIMA supporting the PO module only at the first session in Matoto;
 - IMCI/PO indicators were integrated into the district supervision grid
 - AIRE provided technical, logistical and financial support for district supervision (From June 2021 to August 2022)

AIRE research demonstrated the addition of PO to the IMCI consultation identified an additional 0.9% of severe cases.³⁶ This was the lowest added value across the 4 AIRE project countries and may have been due to higher sensitivity of Guinea's IMCI classification for 'severe' illness. There was no evidence this compromised policy changes or commitment to institutionalize the intervention.

AIRE evidence has been disseminated locally, regionally and globally, and supported a commitment from the Guinean government to promote use of PO.

- AIRE supported the first World Pneumonia Day event in Guinea in 2022, in partnership with the Guinean Association of Pediatrics, to disseminate preliminary findings and initiate advocacy for revision of national IMCI guidelines in 2023. The event was chaired by the Health, Gender and Inclusion Advisor to the Prime Minister and attended by the Deputy National Director of Family Health and Nutrition, paediatricians from Conakry hospitals and NGO representatives.
- At the 2nd International Pneumonia forum in Madrid in April 2023, the Guinean delegation made a commitment to promote the use of PO. AIRE research would have been a factor in accelerating this decision according to a participant in this forum.

³⁵ AIRE. Rapport de capitalisation AIRE. Janvier 2023

³⁶ AIRE_Rapport_résultats de la recherche VF du 12 06 2023 : Rapport des résultats du volet Recherche AIRE

Scale and sustainability

Readiness for scale and sustainability is a mixed picture as some, but not all, national guidelines have been updated and financing for expansion beyond project areas is uncertain. Advocacy approaches are more likely to be sustainable, but community mobilisation less so.

- Within project areas, the use of PO has been authorized in the Matoto and Telimene districts following its introduction in national guidelines, pending the revision of training materials.
- As described earlier, AIRE developed training tools for use of PO during IMCI consultations. National training guidelines were not revised over the project period as these had recently been updated (2019), with the next updates scheduled for 2023, led by the Direction Nationale de la Santé Familiale et Nutrition. Following project closure, there is uncertainty regarding available financing for this update which consists of validation by a high-level committee, followed by a 5-day workshop. As the Ministry of Health authorities did not opt to integrate SpO2 saturation measurement into existing IMCI training modules, a workshop organized under the lead of the national maternal and child health programme has permitted development of a technical note with guidance for integrating the pulse oximeter into IMNCI guidelines.
- Importantly, PO has been integrated into the “Normes et Procédures en Santé de la Reproduction” (2021). This document defines the equipment, infrastructure, drugs and consumables required for each type of health facility. Pulse oximeters and oxygen extractors are now recommended at the health center level, which is an important complementary policy to eventual revision of national IMCI guidelines and training tools.
- AIRE’s approach of working closely with the National Coalition of Civil Society Organizations for the Promotion of Reproductive Health and the Repositioning of Family Planning was a more sustainable approach to advocacy for uptake of PO, though whether advocacy continues past project closure could not be determined in the case study and may be too soon to assess.
- Quarterly supervision continues despite the end of the project supported by the districts from their own funds. Reports for the 2023 first two quarterly supervisions were made available at the communal health directorate of Matoto for confirmation.

Challenges to scale and sustainability

- ALIMA conducted a study to estimate the costs of scaling up PO, where the average cost of the various scenarios would be around 4% of the Ministry of Health’s annual budget. While this has not yet been validated and disseminated, given this is a significant sum, a more cost-efficient approach will be needed. Anecdotally, given limited domestic financial resources, district Annual Work Plans (AWPs) are highly influenced by external partners’ (i.e. donor funded) priorities (rather than a systematic vision of district-specific problems), therefore financing for PO scale up will also require advocacy with development partners to include PO within funded initiatives.
- Since AIRE closure, stakeholder opinion is that ASC community mobilization is not being monitored owing to the end of incentives. The challenge with sustainability of interventions which involve incentivizing community health workers is well documented in Guinea.

Conclusions and lessons learned

AIRE, together with Guinea’s health authorities have created an environment conducive to PO introduction in IMCI, as demonstrated by the revision of IMCI algorithms with clear political will and commitment. According to the National Director of Family Health and Nutrition, *“the revised documents will henceforth be used in IMCI and Community IMCI”*. The initial AIRE project results have generated enthusiasm among stakeholders for scaling up PO use in the healthcare system.

Overall, the project research dissemination was too short and thus continued engagement to review and disseminate local experience is an area requiring further support, alongside advocacy with national civil society

and other stakeholders, including development partners. This includes a review of ALIMA's analysis on the costs to scale PO and consultation with national stakeholders, including with budget stakeholders given that financing for scaling PO within IMCI has not been secured. Further, the need to scale key complementary interventions including availability and access to medical oxygen, remain challenges to be overcome for impact at scale in Guinea. Finally, while the project engaged community health providers, there is an early indication their engagement is not sustained beyond project close and is an area requiring further consideration in project planning.

B.3. LIST OF STAKEHOLDERS INTERVIEWED

Table B.2: List of country level stakeholder consultees for Guinea

Organisation	Name	Position
Grantees/Sub-grantees		
ALIMA	Sory KEITA	National project manager/Head of mission
Government		
Ministry of Health	Djeney Fadima KABA	PI - Directrice Nationale de la Santé Familiale et de la Nutrition (DN)
Ministry of Health	Facely CAMARA	Direction Nationale de la Santé Familiale et de la Nutrition DNA
Ministry of Health	Ibrahima Sory Diallo	CoPI - DG de l'Institut de la Nutrition et Santé de l'Enfant
Ministry of Health	Madina SISSOKO	Directrice Communale de la Santé de Matoto
Ministry of Health	Mory Fodé SOUMAH	Assistant chargé de la surveillance à base communautaire
Société Guinéenne de Pédiatrie et Réseau de recherche clinique en Pédiatrie	Ibrahima Sory Diallo	Président de la Société Guinéenne de Pédiatrie et Réseau de recherche clinique en Pédiatrie
	Amara DIALLO	Réseau de recherche clinique en Pédiatrie
	Abdoulaye TOURE	
	Amadou Oury TOURE	
	Midiaou BAH	
	Moussa CISSE	
Consultant Indépendant	Yéro-Boye CAMARA	Chargé de l'étude d'estimation des coûts de passage à échelle de l'OP

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Appendix C INDIA CASE STUDY

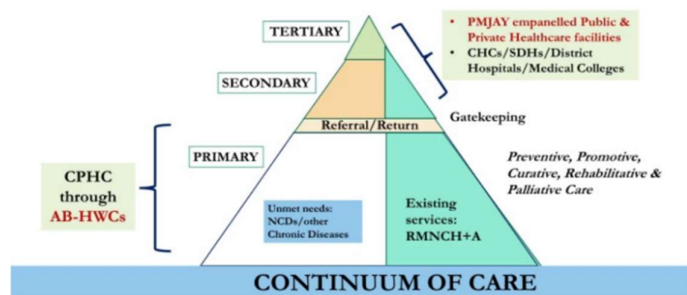
C.1. BACKGROUND AND CONTEXT

Key country characteristics

Over the last 3 decades, India has achieved remarkable progress in child health, reducing under-five mortality from 126 deaths to 32 per 1000 children between 1990 to 2020.³⁷ This comes as a result of continuous government and partners efforts to strengthen the national public health system and increase access to healthcare across the country.

The government has made access to healthcare through public facilities free for all Indian citizens and has recently launched the Ayushman Bharat program with the vision of strengthening primary healthcare as a foundation for the health system³⁸. Under this program, the Ayushman Bharat Health and Wellness Centres AB-HWCs (combining primary health centres and subcentres) are being upgraded to provide comprehensive health care services to all including free essential medicines and diagnostic services. PHC is also envisioned as the first point of contact into the health system, acting as a gatekeeper to better manage patients volume at secondary and tertiary level and improve efficiency in the whole system.

Figure C.1: Ayushman Bharat continuum of care. MHFW (2022).



However, despite these efforts, the public health sector continues to suffer chronic systemic issues including severe shortages of staff and lack of medical supply in facilities³⁹. As a result, many people turn to the private sector in an attempt to get better healthcare, leading to high out-of-pocket expenditures to cover healthcare cost which pushes lower-income households further into poverty⁴⁰.

In addition, the country health system operates under a fully decentralised model, with each state primarily responsible for organizing health services in their constituency. There are significant nationwide variation in coverage, availability, and access of services across states⁴¹, widening health disparities between poorer and richer states and creating a large rural-urban gap in health outcomes and under-five (U5) mortality⁴².

³⁷ UNICEF (2023). India country profile: Trends in under-five mortality rate. <https://data.unicef.org/country/ind/>

³⁸ Ministry of Health and Family Welfare. Government of India. (2022). Ayushman Bharat - Health and Wellness Centres.

³⁹ Columbia University Mailman School of Public Health (2023). India: Summary. <https://www.publichealth.columbia.edu/research/others/comparative-health-policy-library/india-summary>

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⁴² Piyasa, C. and Saikia, N. (2022). An update on explaining the rural-urban gap in under-five mortality in India. *BMC Public Health*. <https://bmcpublichealth.biomedcentral.com/articles/10.1186/s12889-022-14436-7>

Overview of TIMCI in India

In India, like in many low- and middle-income countries (LMICs), the burden of diseases continues to be high and child mortality is often driven by preventable deaths from infectious diseases like pneumonia, diarrhea and malaria. Poor access to healthcare and weak health systems are exacerbated by a lack of appropriate tools to diagnose and manage sick children effectively⁴³. In 2019, India alone accounted for 11% of global childhood pneumonia deaths, the second highest worldwide⁴⁴.

The Tools for Integrated Management of Childhood Illness (TIMCI) project, aims to tackle this issue by accelerating the availability, adoption, and scale-up of tools to identify severe illness in children and ultimately contribute to decreasing U5 mortality. The project outputs are as follow:

- Output 1: Introducing pulse oximetry (PO) and electronic decision support tools (eCDSTs) in PHC facilities in four focus countries including India (CHC facilities were also included in India).
- Output 2: Generating evidence to support LMICs in their decision to scale up PO and eCDSTs into PHC settings and inform global level decisions to update guidelines, policy, and recommendations.
- Output 3: Implementing market strengthening for adapted MMs to help catalyse the market for non-invasive MMs that can support improved diagnosis and management of severe illness at the PHC level in LMICs.
- Output 4: Creating conditions for national and global scale-up to contribute to transition and scale-up of PO, eCDSTs, and MMs as part of a broader package of lifesaving child health technologies in LMICs.

TIMCI India ⁴⁵	
State of implementation	Uttar Pradesh
Sub-location	Unnao, Sitapur, Deoria districts
Timeframe:	July 2019—March 2024
Budget	\$2,513,092 ⁴⁶
Expected Impact:	Improve the detection of severe disease in children U5s by equipping PHC workers with PO and decision support tools to enhance their ability to diagnose severe disease and accelerate the development and market entry of non-invasive multimodal devices.
Implementation facilities	Primary Health Centers and Community Health Centers
Number of facilities	117 implementation facilities 6 referral (District) hospitals
Observer states	Andhra Pradesh, Madhya Pradesh, Odisha, and Rajasthan



⁴³ PATH (2019). TIMCI Project Plan

⁴⁴ Goli et al (2022). Childhood Pneumonia and Its Associated Factors in India. *Save The Children*, New Delhi

⁴⁵ PATH (2023). TIMCI overview presentation [GH Unitaied Evaluation IMCI 4432 - TIMCI overview 3May2023 Shared.pdf - All Documents \(sharepoint.com\)](#)

⁴⁶ PATH (2023). Updated Annual Report

C.2. KEY FINDINGS

Relevance, Coherence

TIMCI was highly relevant to public health needs in India / Uttar Pradesh state and responsive to the need for documented evidence to inform policy and decision making

- Before TIMCI, POs were used mostly as monitoring tools in hospitals and rarely at PHC level. There was poor awareness and poor availability of adapted devices for neonates and U5 children despite a strong public health need (e.g., high prevalence of childhood fevers and pneumonia, poor triage and differential diagnostic capacity etc.).
- COVID-19 popularised the use of standard fingertip PO in the country but TIMCI focus remained highly relevant as available POs were often not of medical grade and not adapted for U5.
- Research component to document evidence around cost effectiveness and impact of PO increased project relevance seeing the lack of available evidence on the topic to influence policies.

“Everyone knows that PO works but the research will provide hard data to inform decisions”, India stakeholder.

The project demonstrated strong engagement with state government and good alignment with state priorities and existing systems

- India project team ensured consistent engagement with state National Health Mission (NHM) and district health officials from the onset of the project to promote government buy in and support of interventions. Engagement was done through quarterly meetings with representatives of the NHM Child Health Division as well as regular engagement with districts' chief medical officers and other national stakeholders.
- Project focus on PHC and CHC to introduce PO is well aligned with government efforts to strengthen PHC as the backbone of UHC and reduce pressure on secondary/tertiary care to improve healthcare efficiency⁴⁷.
- Project leveraged national systems and embedded activities in existing health systems processes to avoid duplication e.g., clinical supervision and PO training done through state systems, community sensitisation activities embedded in state run ASHA programs etc.

... However project design coupled implementation and research very strongly, perhaps at the detriment of needed implementation flexibility

- Although RCTs are recognised as gold standard to produce strong evidence, stakeholders flagged that they are not practical to implement in the context of the public health system in India, especially because of the method complexity and rigor of protocol:
 - Eligibility criteria e.g., presence of a medical officer in facilities, made requirements hard to meet in some facilities due to high turnover and transfer of staff.
 - Protocol quality requirements around storage of data required practical adjustments to adapt facilities (e.g., procuring and placing locked cabinet in often crowded consultation rooms).

⁴⁷ Noting that CHCs are part of secondary healthcare under the new Ayushman Bharat program

- Majority of stakeholders believed the chosen research method was limiting overall and that the project could have benefited from a more flexible approach through either a slightly modified version of RCT or using another method (e.g., observational studies, implementation research) that could be better adapted to the context.

Research focus also implied limited use of CDSA and limited scope for adaptation to better respond to India's public health system

- CDSA component could have been a relevant intervention in the country seeing government efforts to digitise system and the need to strengthen low-skilled health worker capacity to respond to shortage of clinicians.
- However, most stakeholders suggested that the poor CDSA uptake was likely due to an inadequate intervention design rather than relevance of tool itself as the tool and intervention protocol could have been better adapted to local context.

“CDSA was introduced with the assumption that it would be accepted straight away, not recognising the need to couple intervention with behavioural change approach to facilitate acceptance”

- The CDSA intervention was hampered by its design for a number of reasons:
 - (i) the length of process when using the CDSA increased consultation time from 1–2 minutes to 6–15 minutes. The length of the process was potentially exacerbated by reported issues in the tool interface e.g., application glitches, log-outs, lags, and slowness of the device as well as users not lack of familiarity with tool technology⁴⁸.
 - (ii) the choice of HCWs targeted to use the CDSA (medical officers) was not the most appropriate as high patient load and shortage of staff makes it impossible for clinicians and medical officers to increase their consultation time to use tool.
 - (iii) HCPs and stakeholders consulted believed that CDSA would be more relevant for basic HCWs who would benefit most from decision making support rather than specialist/qualified doctors. This was also observed during the project pilot as post-pilot analysis⁴⁹ showed that HCPs with less clinical training (e.g., AYUSH) were more likely to appreciate the assistance from the CDSA compared to HCPs with more training (e.g., MBBS doctors, paediatricians).
 - (iv) some stakeholders shared that the chosen research method (RCT) limited possibilities to make any adjustments or adaptations to the CDSA intervention.
 - (iii) CDSA algorithm had been coded to follow IMCI procedure when IMNCI is not being used in India.

The scope of the multimodal country interventions could have been more ambitious especially seeing rapid changing landscape and fertile manufacturing environment in India

- Majority of stakeholders confirmed MMs high relevance for India and UP, especially for MM+RR and MM+Hb tools in view of poor respiratory rate counting practices in healthcare (“rarely performed” according to some stakeholders) and the need for non-invasive haemoglobin testing due to the prevalence of anaemia in the population.
- Some stakeholders shared that the project missed an opportunity to fast track adoption of MMs especially in light of a rapid changing environment (i.e., more manufacturers developing MMs) suggesting that standard PO may become obsolete soon, in addition to a growing interest in tool for its multiple functions.

⁴⁸ PATH (2023). TIMCI CDSA learning report

⁴⁹ PATH (2023). TIMCI CDSA learning report

- Stakeholders flagged high price/poor affordability and low device competition on the market would remain key barriers in the short to mid-term horizon. Market shaping activities could have targeted these challenges more directly however, the MMs interventions implemented at national level were more focused on the demand side (e.g., Hybrid study exploring accuracy and feasibility of tools use in context). Stakeholders also emphasised that government uptake would be facilitated if there were multiple products manufactured in India.

India team was able to adapt project beyond global portfolio framing focused on IMCI which was not as relevant for India

- Portfolio focus on IMCI as a gateway for PO introduction, was not relevant for India as IMCI is not systematically implemented as envisaged in the WHO guidelines in the country or UP.
- Decision to expand PO introduction beyond IMCI in India (e.g., PO was used on all children, not just through IMCI consultation) was necessary and demonstrated good adaptation to contextual needs.

Efficiency

Project significantly delayed by C19 and research protocol design and approval (for MM hybrid study)

- Project delayed by two years due to pandemic led to compression of overall project activities into shorter timeline and significantly impacted advocacy and dissemination timelines.
- Stakeholders highlighted that this delay may have been an influencing factor in decision to drop CDSA within six weeks of pilot as RCT needed to start and no more time could be spared to adapt CDSA intervention further.
- Medical officer transfers caused some facilities to become ineligible and further contributed to delays as new facilities needed to be assessed to ensure research could reach targeted sample size. Adding facilities originally allocated to the CDSA arm helped mitigate this issue.

Credibility and expertise of project implementers and in-country partner highly contributed to project success

- Expert project team, very knowledgeable of their context and well connected to state and district stakeholders increased the project acceptance and implementation.
- Use of credible local research partner KGMU trusted by government increased project profile and strengthened influence on gov for findings uptake and PO adoption.

Effectiveness and Impact

Project has successfully increased awareness around benefits of using PO at PHC/CHC level and generated demand for the tool across project facilities

- Key government officials and national stakeholders have confirmed the contribution of the project to bringing attention to the need for adapted tools for all children, which are still missing despite the recent popularisation and high uptake of the standard fingertip PO in the country.
- All medical officers consulted shared that they believe using PO improves the quality of care provided to patients as it enables them to determine children oxygen saturation with more accuracy and take more informed decision regarding children care management.
- During facilities visits, the evaluation team was able to observe that PO was still being used in the visited facilities (e.g., PO device visible in the consultation room and evidence of recent SpO2 recordings in patient register) including in facilities where project intervention had been stopped (e.g., 1 former CDSA facility visited).

- However, there is a need to increase sensitisation and awareness raising across all healthcare workers beyond medical officers:
 - Other health facilities staff interviewed (e.g., nurses) seemed to have limited awareness of the need for an adapted tool for U5 and district hospital staff shared that they believe the standard fingertip PO is appropriate for use in children over 1y.
 - The district hospital visited had no PO adapted for use in children and were using a standard PO device in paediatric wards.

National health system presented both a conducive environment for PO adoption as well as systemic challenges that could limit its impact

- Covid-19 has accelerated the production and availability of medical oxygen as well as popularising the use of standard fingertip PO in India offering an opportunity to fasten PO integration as part of oxygen management systems:
 - Oxygen was readily available across all facilities visited (district hospital, CHC and PHC) and health facility staff demonstrated a good understanding of the need for PO to monitor patient receiving oxygen. Across facilities, staff confirmed having trained personnel on site to deliver oxygen therapy.
 - During C19, the government distributed standard fingertips PO across all levels of care including for ASHAs to use in communities. This increased healthcare workers and communities awareness and acceptance of PO and which the project was able to build on to introduce handheld devices.
- However, health systems challenges may limit consistent use and full effectiveness of PO:
 - PO was often used directly during consultation and not necessarily to facilitate patient triage as there was no dedicated triage process at PHC and CHC facilities. Rather, patients were mostly seen on a first come first serve basis due to the high volume of patients exacerbated by a shortage of staff.
 - Selective and inconsistent use of PO as overburdened medical officers do not have time to use PO on all children and only uses tool on patients showing severe symptoms during consultation.
 - Poor trust into public healthcare was a key risk to the project as it leads people to seek out healthcare from the private sector most often and creates a tendency to bypass PHC level - stakeholders confirmed majority of population seek care directly in private facilities or bypass PHC/CHC to go directly at district hospital level due to poor trust in quality and capacity at CHC and PHC level.

“Only ~15% of patients come from referral, most usually come directly” District hospital nurse.

Although the effectiveness of CDSA could not be demonstrated, stakeholders shared a strong interest in the tool seeing positive feedback from the pilot on CDSA potential benefits to support better decision making in healthcare

- Although the CDSA pilot demonstrated low uptake of the tool, HCPs reported that the CDSA improved their clinical practice and quality of care according to document feedback in the project CDSA learning report⁵⁰ as well as stakeholders feedback collected during the case study.
- The project piloted still provided some helpful learnings around potential adaptations that could be made to improve the feasibility of future CDSA pilots in the country.

The project market shaping interventions may serve as a stepping stone to increase demand for MM in the country however, it would have required more catalytic interventions (especially around affordability) to meet its objective of market acceleration

⁵⁰ PATH (2023). TIMCI CDSA learning report

- National stakeholders including state officials have shown great interest for MMs, however they have flagged that affordability still remains a key barrier.
 - According to PATH Market Intelligence Report⁵¹, MMs price would need to be around \$100-200 to compete with both handheld and fingertip markets. However, there are currently only 3 available MMs that are fully functional for paediatric and neonatal use start from \$300 (one product) and \$500-2000 (two other products)⁵².
- The project produced a few market shaping outputs that could be used to inform government decision making around procurement of MMs (e.g., TPP, products landscape etc.) although there is limited evidence that these have been used at national level yet.
- Although the removal of the financial incentive to manufacturer in the MMs output was done as a response to the changing landscape, stakeholders shared that more could have been done to directly target affordability to accelerate access to existing MMs, especially considering LMIC buyers high sensitivity to price.

⁵¹ PATH (2021). PATH Market Intelligence Report on Multimodal Devices

⁵² PATH (2022). Next Generation Pulse Oximeters: Technology and Market Landscape

Table C.1: Available and pipeline multimodal devices for under 5 children – adapted from PATH market landscape report (2022)

Product	Functionalities	Target population	Price	Stage
Fully functional available for U5s				
Pronto (Masimo)	SpO2, pulse rate, Hb	<ul style="list-style-type: none"> Adult and paediatric populations 	\$500-2000	Market entry
Radical-7 (Masimo)	SpO2, pulse rate, Hb	<ul style="list-style-type: none"> Adult, paediatric, and neonatal populations 	\$500-2000	Market entry
NeoGuard (Neopenda)	SpO2, pulse rate, respiratory rate, temperature	<ul style="list-style-type: none"> Adult, paediatric, and neonatal populations 	\$300-380	Market entry
Partially functional for U5s				
Rad-G (Masimo)	SpO2, pulse rate, respiratory rate, temperature	<ul style="list-style-type: none"> Adult, paediatric, and neonatal populations Neonatal probe for respiratory rate not cleared by US FDA 	\$300 with temp	Market entry
Rad-67 (Masimo)	SpO2, pulse rate, Hb	<ul style="list-style-type: none"> SpO2 and pulse rate indicated for adult, paediatric, and infants Total Hb not intended for use on paediatric patients and pregnant patients 	\$500-2000	Market entry
SatLite Touch (Zug Medical Systems)	SpO2, pulse rate, respiratory rate, temperature, ECG	<ul style="list-style-type: none"> EU CE mark for device without respiratory rate, temperature, and ECG Pending US FDA approval for adult, paediatric, and neonatal populations 	\$100-200	Verification and validation
Scanbo D8 (Scanbo)	SpO2, pulse rate, respiratory rate, temperature, glucose, blood pressure, ECG, pulse rate variability	<ul style="list-style-type: none"> Adult populations Performance validation in paediatric and neonatal populations underway 	~\$200	Market entry
M800 Respiratory Rate (BioLight)	SpO2, pulse rate, respiratory rate	<ul style="list-style-type: none"> Without respiratory rate feature for adult, paediatric, and neonatal populations 	<\$200	Verification and validation
EzeCheck (EzeRx)	SpO2, Hb, creatine, glucose	<ul style="list-style-type: none"> For use in patients aged four years and older Pending validation for use in children aged 30 months and older 	~\$632	Verification and validation / Market entry

The project Community engagement CCSE strategy was very light touch and there was limited evidence that it translated into tangible behaviour change in care seeking behaviour and is not viewed as sustainable

- Community and civil society engagement (CCSE) mostly implemented through community health workers (CHWs) – AHSAs to increase caregiver awareness and understanding of care-seeking, screening, diagnosis, and referral processes at primary health care facilities.
- The project reported training ASHAs and Sangini⁵³ through workshops, meetings and training of trainer with the aim to reach a catchment population of around 3.5 million people. The project also provided targeted information, education, and communication (IEC) materials to use on during community outreach activities.
- However, feedback from a small sample of ASHAs demonstrated limited uptake of the training information, suggesting that a longer, more comprehensive CCSE intervention would be needed to really translate into concrete contribution to behaviour change (encouraging population to attend referrals, community use of public sector rather than private...).

Sustainability and scalability

Project progress to date has been limited to the project sites and there is a risk for sustainability and scalability as the project advocacy and dissemination time has been highly compressed due to the project delays.

- Project delays have significantly reduced the time for advocacy and dissemination activities leaving a very short window for these activities to take place before the end of the project (an estimated five months for RCT and three months for the hybrid study).
- Some in-project advocacy was done to relay ongoing progress and information on providers acceptance to stakeholders, which helped secure government buy-in ahead of the research results. The country team has continued to meet regularly with MoH and partners including state procurement and distribution agencies, district officials, and subdistrict- and facility-level stakeholder etc. to build early champions in support of PO scale up.
- Seeing the current level of government buy-in as well as state ownership of financing and procurement decisions, stakeholders feedback suggest high chances of sustainable adoption of PO at state level so long as policies and guidelines are updated accordingly (e.g., based on project research results). To date there has been no policy change in the state, with government stakeholders awaiting the research results from the project.
- The timelines of the project imply a degree of risk in terms of whether planned advocacy and dissemination will be sufficient and timely to support policy change. Currently the dissemination phase is very compressed and may not be adequate. Also, they may not align with the timing of the state annual implementation plans, which is critical to ensure inclusion of POs.
- On the policy front, the Social Awareness and Actions to Neutralize Pneumonia Successfully (SAANS) Initiative was identified as a priority advocacy target and as a result:
 - The team amended its advocacy plan to focus on influencing SAANS authorities and embed U5 adapted PO procurement in the next SAANS procurement round.
 - A draft policy addendum to the national SAANS guidelines was developed, highlighting gaps across policy, procurement, maintenance, financing, and other parameters of the policy.

⁵³ PATH (2022). TIMCI annual report

- However, the project focus on the SAANS may have reduced stakeholders attention to other key policies and processes where PO should be included, highlighting the need for a comprehensive policy and process mapping as part of the project transition plan.
- Finally, the project did not have a strong focus on the need for maintenance interventions. However, should the Government move away from standard PO and adopt handheld devices or MMs, it will have to factor in the required resources to ensure PO is introduced with the relevant supporting package including, capacity for maintenance as well as the necessary spare parts to use the tool across populations. We understand that the government in UP state has a standard maintenance contract with an agency in the state for all health care products and it would be possible to roll in POs into this arrangement as well.

Scalability of the projects interventions will be highly dependent on further advocacy, also noting the decentralised system in India

- The project is being implemented in one state of India, and scale-up across the country will require transfer of knowledge and advocacy amongst other Indian states as well. It is not clear if the project will be able to do this adequately in the compressed timeline for research dissemination.
- As of February 2023, the project scalability framework showed that most scalability conditions were still unmet, graded at 2 and 3 over 5 to signify that “Plans have been developed and activities started towards creating condition” or “Plan were under development for what is needed to achieve condition”⁵⁴.
- Although political buy-in seem to have been secured in the project state (UP), scalability across states will require strong advocacy and influencing to ensure commitment, secure financing for PO and ultimately translate policies into implementation. So far, the project has established contact with the selected observer states though engagement has been minimal.

Opportunities and recommendations

Overall, India provides a unique case study for the acceleration of PO adoption for a number of reasons, including the decentralised health system, the rapid development of its oxygen system after COVID, the country limited dependence on donor funding for PO procurement and the growing country manufacturing capacity to develop affordable tools, compared to other countries in this portfolio.

Unitaid and the grantees, will need to develop a dissemination plan with opportunities for continuous knowledge sharing and advocacy not only in the final months of the project, but most importantly beyond project closure. Advocacy and dissemination of the project and research findings are essential aspects to ensure that the project interventions are sustained, that progress made to date are not lost and that lessons learned inform future interventions. This includes through:

- Identifying clear mapping out key state and federal strategies, policies and processes that would need to be update to ensure PO uptake and scale up (e.g., SAANS guidelines targeting states child health strategies).
- Aligning their dissemination plan with key policy and processes review cycles to influence appropriate audiences (e.g., presenting at the National Health Systems Resource Centre (NHSRC) next meeting and participating in next budget cycle).
- Implement a decentralised state-to-state advocacy approach across UP and other states supported by high-level advocacy at federal level to influence nationwide policies.

⁵⁴ PATH (2023). TIMCI Scalability Report, February 2023.

- Strengthen knowledge sharing across all key groups including academics, healthcare providers and most importantly the private sector to ensure a holistic uptake of adapted PO for U5 across the health system.

Although no acceleration of MMs introduction have been achieved per se, stakeholders have expressed a lot of interest in MMs, to better respond to the need for diagnostic capacity across diseases. Unitaid and the grantees should ensure clear next steps are identify to build on the market shaping interventions in this portfolio and progress achieved so far, including by:

- Ensure that the various outputs created (e.g., TPP, landscape, hybrid study etc.) are effectively disseminated (using diverse tools and formats) and used by intended primary users (who should be clearly identified).
- Explore the opportunity to tap into India growing manufacturing capacity by strategically engaging with Indian manufacturers (e.g., Scanbo) to support local manufacturing and accelerate and the development and availability of affordable MMs on the market.

The short project CDSA pilot highlighted a strong interest in the country to increase healthcare staff decision making capacity through digital solutions, and provided potential example of changes and tweaks that can be adapted to design a better tool for India. Unitaid and the grantees should where possible, explore options to build on this project learnings and re-pilot a better version of the CDSA in India. This may include:

- Targeting lower levels (health and wellness centres) or less qualified HCW (e.g., Ayush) to use PO as triage tool and consolidate their decision making capacity.
- Exploring other type of implementation and research methods with more flexibility to allow necessary adaptations and complement the intervention with a behaviour change approach to increase acceptance of the new digital innovation.

A key lesson learnt from this project to Unitaid has been around the opportunities, risks and challenges of tightly combining project implementation with research studies. Although there is undoubtedly a strong incentive and multiple benefits to generating evidence through this approach, this may limit the project flexibility to adapt to complex local contexts and ultimately hinder project success. As such, for future projects, Unitaid could:

- Explore opportunities to design more hybrid model of implementation studies for future investments where project implementation can be more independent from research.
- Consider the trades-off of using strong but potentially rigid research methods (such as RCTs) versus flexible but potentially less robust methods (e.g., observational studies) to identify the most appropriate one for the intervention context based on the proposed objectives.

C.3. LIST OF STAKEHOLDERS INTERVIEWED FOR INDIA CASE STUDY

Table C.2.: List of country level stakeholder consultees for India

Organisation	Name	Position
Grantees/Sub-grantees		
PATH	Dr. Kovid Sharma	Project lead, TIMCI
	Dr. Aурpit Patnaik,	State Lead, Uttar Pradesh
	Neeraj Dixit	State Program Officer, TIMCI
KGMU	Dr. (Prof) Shally Awasthi	PI - TIMCI, Head of Department, Pediatrics
	Dr. Divas Kumar	Research lead, TIMCI

Organisation	Name	Position
Government and Facilities		
Ministry of Health/ UP National Health Mission	Dr. Ved Prakash	General Manager, Child Health, National Health Mission
	Devendra Kumar	District coordinator
PHC Kamlapur	Dr. Mohd Shahid,	Medical Officer
CHC Hargaon	Dr. Jitendra Kumar	Medical Officer
	Group of ASHA and Sangini (6)	
District Hospital, Sitapur	Nursing matron and staff nurse	
	Nursing staff, PICU	

C.4. REFERENCES

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PHASE 2 CASE STUDIES

Appendix D **KENYA CASE STUDY**

This appendix presents the summary findings from the country case study on Kenya which was one of the TIMCI implementation countries. It has been developed based on (i) in person and virtual consultations with national stakeholders and representatives from Kakamega county, one of the three project counties (Section A.5. includes a list of consultees); and (ii) a review of documentation and data.

The Kenya case study was conducted over 26 February to 8 March 2024, **prior to formulation of key messages from the final TIMCI study results** and their dissemination at national and sub-national levels. This dissemination was planned to take place during March and April 2024.

D.1. COUNTRY CONTEXT

Kenya is one of four countries where the TIMCI project was implemented over 2019-2023, of which two are in East Africa (Kenya and Tanzania). Child mortality has steadily declined over the last two decades, with the most recent DHS data indicating a significant reduction from 52 to 41/1,000 live births (2014-2022). The majority of deaths among children under-five occur in the first year of life (78%) and neonatal period (51%).⁵⁵ Malaria, followed by pneumonia, are the leading cause of child mortality, and malaria prevalence varies considerably by season and across geographic regions. The Division of Newborn and Child Health (DNCH) within the Ministry of Health is responsible for national child health policy setting, including IMNCI.

Kenya's health system is devolved, with the national level responsible for policy making and quality control, and decision-making and implementation devolved to the 47 counties. Universal Health Coverage (UHC) has been advanced under both the previous and current governments; the recent Primary Health Care Act outlines how primary health care (PHC) will be strengthened to deliver UHC, namely through a hub and spoke model comprised of primary care networks⁵⁶ (PCN) and formalising community health services delivered by community health promoters (CHPs). In September 2023, CHPs were formalised by the national government, defining an essential health package and provision of a minimum stipend.⁵⁷

D.2. UNITAID COUNTRY SUPPORT

The TIMCI project is implemented by PATH, in partnership with the Division of Newborn and Child Health (DNCH), and the counties of Kakamega, Kitui and Uasin Gishu. It is implemented in 60 facilities across select sub-counties of Kakamega, Kitui and Uasin Gishu. The main objectives of the TIMCI project are:

- To improve the ability of healthcare providers (HCP) at the PHC level to diagnose moderate to severe disease by equipping them with pulse oximeters (PO) and tablet-based an clinical decision support algorithm (CDSA); and
- To accelerate the development and market entry of non-invasive devices that augment the features of standard PO with one or more additional vital sign measurements.

In support of these objectives, TIMCI included two research components in Kenya:

⁵⁵ Kenya DHS (2022). <https://dhsprogram.com/pubs/pdf/PR143/PR143.pdf>

⁵⁶ Primary referral hospitals will serve as hubs, supporting several spokes (e.g. dispensaries and health centers, linked to community health units).

⁵⁷ CHP stipend is topped up in some counties.

- i. A quasi-experimental pre-post study, led by the University of Nairobi (UoN), to evaluate the impact of use of pulse oximetry and the CDSA on clinical & quality of care outcomes and understand mechanisms of and facilitators & barriers to implementation (in collaboration with the global study partner STPH).
- ii. A field-based hybrid study to accelerate pulse oximeter/respiratory rate multimodal (MM) device market entry, led by the Kenya Paediatric Research Consortium (Keprecon). The MM hybrid study was conducted in two health centres (Njiru and Mathare North) in Nairobi county in 2023.

The TIMCI intervention consisted of the following main activities (*not exhaustive*)⁵⁸:

- Training health providers at PHC level in IMCI and use of PO, with follow on support. Select HCPs received a five day IMNCI training, including use of PO. Follow on clinical support to PHCs included i) clinical mentoring for continuous learning and to mitigate gaps due to staff turnover; ii) supportive supervision (by PATH, national and county MOH teams). A remote PO training (self-paced modules, participant-initiated practice on real children, and live online workshop) was also employed. TIMCI also introduced Continuous Medical Education (CME) for different PHC roles (e.g. recordkeeping).
- Procurement of PO and essential equipment at PHCs, and child health medicines for referral facilities to ensure adequate treatment commodities would be available (the Acare PO was procured). PHCs received oxygen compressors to provide pre-referral treatment on an as-needed basis.
- Introduction of a tablet-based CDSA. This included a 3-day CDSA training for PHC staff, with technical support from PATH.
- Review and update of the supportive supervision tool and referral forms for children to include use of PO for children, oxygen use for children in treatment, and documentation on drugs and commodities.
- Social and behaviour change communication (SBCC), led by CBO and CSO partners.⁵⁹ This included community awareness and demand generation to promote care seeking and follow-up on referral recommendations, sensitize communities that PO and CDSA were in use at PHCs, and advocacy in support of TIMCI goals with county governments and key opinion leaders.

D.3. KEY FINDINGS

Relevance and coherence

The national policy context was highly conducive to the TIMCI intervention package, specifically Kenya's PHC vision and priority of improving quality of care along with the wider context of health worker shortage at the primary care level. TIMCI was timely in Kenya in that it coincided with a policy environment of revitalising primary health care, along with efforts on quality of care⁶⁰, and national priority of digitization in the health (and other) sectors. More specifically, the project design (specifically PO, CDSA, ongoing supervision support) was reported by national and county stakeholders as overall highly relevant and coherent with national child health priorities and the public health system, evidenced by the following:

- **The start of TIMCI coincided with Kenya's 2019 IMNCI guideline update to include measurement of oxygen saturation, though pulse oximetry was not yet available at PHC level.** In 2018/19, the DNCH included oxygen saturation assessment for children presenting with a cough or difficulty breathing in the

⁵⁸ PATH Annual TIMCI reports (2021, 2022).

⁵⁹ CSO partners are Anglican Development Services North Rift (Uasin Gishu County), Anglican Development Services Eastern (Kitui County), Matunda Jua Kazi Organization (Kakamega County).

⁶⁰ Such as implementation of WHO quality of care standards, which includes correct assessment and management of patients.

IMNCI policy. TIMCI was timely in supporting the DNCH to revise its tools as part of this policy change and support the rollout of the updated IMNCI guidelines. Another update to the IMNCI guidelines is anticipated in 2024 and TIMCI results are expected to inform decisions.⁶¹ The DNCH reports that at baseline, fewer than 10% of PHCs had a functional PO and approximately 57% of counties had some providers trained in IMNCI and that coverage was variable.

- **The CDSA was viewed positively by both health care providers and county health officials – both in regard to supporting standardization in healthcare provision, and as an aid for lower-skilled providers. The lack of interoperability with the digital ecosystem was a main drawback to CDSA design.** County stakeholders professed the CDSA to be “game changer” as it supports a standardized assessment of the sick child in a context of variation in clinical skills and mitigates providers taking “shortcuts”. Positive views on the CDSA were expressed by all levels (county to national), and further viewing the introduction of digital clinical decision tools as a milestone in Kenya’s health service provision. One sub-county stated the CDSA was the first electronic case management tool used in PHCs with the exception of HIV electronic systems. Areas for improvement cited included need for interoperability with Kenya’s digital ecosystem and limitations in how HCPs and health facilities could update and analyse the data collected.⁶² Provider practises in regard to CDSA use and extent the CDSA recommended actions were taken by providers is discussed below (see Effectiveness section).
- The hybrid study to generate user insights and performance data on next-generation pulse oximeters was well designed and forward-looking for Kenya. Government stakeholders professed significant interest in next-generation devices that could perform multiple functions. Results were not available at the time of the case study, but the study team, led by Keprecon, and involving stakeholders from Nairobi county, was considered a strength of the approach in that it involved influential Kenyan stakeholders.

TIMCI was well integrated with the Division of Newborn and Child Health, the county health system and local government. The change in several political leaders in 2023 and turnover in key government focal points has necessitated additional advocacy in support of sustainability and scale. There is strong buy-in for the TIMCI project from county health officials and health providers consulted for this case study.

- Stakeholders reported TIMCI effectively engaged county political leadership to generate buy-in for the programme, such as engaging the previous Governor of Kakamega county who was supportive of TIMCI and technology use in health service provision. PATH worked closely with county health management officials to support project facilities - for instance with regards to CDSAs, PATH were considered very responsive to troubleshoot issues quickly with counties and facility staff.
- During the project period there was turnover in some key national and county level health officials, as well as county elected officials. This was considered to have caused some implementation delays and the need for significant advocacy during 2024 results dissemination.
- Unitaids’ flexibility to support Kenya’s national COVID-19 response through TIMCI was viewed as having strengthened relationships between the TIMCI project/ PATH and counties.

Community mobilisation was well regarded and leveraged existing community structures, however was under-resourced and ended prior to completion of the TIMCI study.

⁶¹ Stakeholders consider it too early to assess what revisions will be included in the 2024 IMNCI guideline update (as the TIMCI study results will also inform decisions), noting however this may expand guidance on oxygen saturation to be assessed for all sick children.

⁶² Other areas for improvement in CDSAs reported included inability of the CDSA to serve as a patient record (i.e. a child’s information was only stored in the tablet used for that consultation, limiting ease of use within a facility for any subsequent visits), plus functional aspects such as not retaining clinical information notes inputted in flexible fields.

- In Kakamega county, community mobilisation was considered instrumental by county health leadership in supporting project goals, whilst also acknowledging its relatively small scale.
 - In this county, the CSO Matunda Jua Kazi (an organisation working in RMNCH) operationalised TIMCI community mobilisation through Kenya’s Community Health Strategy. Community health activities such as ‘dialogue days’ and Community Health Volunteers (now called Community Health Promoters, CHPs) were leveraged to inform communities of the TIMCI interventions, along with behaviour change communication on care seeking for sick children and danger signs.
 - Caregivers were informed select facilities would be using PO and CDSA in consultations to improve the quality of care – this served both to generate demand and to reassure caregivers the CDSA was part of clinical care (and HCPs were not simply “on their phones” during the consultation). Working through the Community Health Strategy enabled TIMCI to leverage, to an extent, existing budgeted activities, given limited resources for the community engagement component.
- Respondents acknowledged the short implementation period of civil society engagement was due to limited project budget. For example, TIMCI contracts with CSOs were for one year (largely in 2022), thus when planning time is accounted for, CSO implementation was approximately six months and was concluded by November 2022. In contrast, the TIMCI study intervention period concluded in February 2023 and would thus not have fully benefited from community demand generation. Patient follow up was reported as limited and challenging to implement within TIMCI as the project did not have the resources to encourage CHPs to do so (e.g. air-time is an incentive commonly expected by CHPs when engaging in specific projects).

The TIMCI study protocol was considered valuable, but overly complex and burdensome. Changes to the study design included better reflecting the innovation uptake ‘curve’.

- Stakeholders considered the intervention and research design too ambitious and complex for the implementation context. Some study components (e.g. focus groups) were dropped in recognition of the high burden of study methods and delays due to the COVID-19 pandemic. The study pre/post design was also adapted to consider how innovations get adopted, namely, to recognise an initial period of low uptake as providers get used to the new technology. The resulting study change was to have (i) a baseline; (ii) an ‘early intervention’ period (early 3 months of PO and CDSAs uptake); and (iii) ‘late intervention’ period – considered to best reflect the true real world uptake and use of the interventions.

Efficiency

TIMCI implementation experienced a number of delays – including adapting the CDSA to local clinical guidelines. The COVID-19 pandemic brought additional knock-on effects to efficient project delivery.

- The technical development and refinement of the CDSA to ensure good performance in a real-world clinical setting took longer than anticipated and stakeholders consider in hindsight a longer period to pilot and iterate the CDSA was warranted. Adapting the CDSA to local clinical guidelines was also a lengthier process than expected.
- Recruitment levels for the baseline data collection beginning November 2021 were below anticipated. Two facilities were added to help meet the target sample size (for a total of 19 facilities) and the data collection time extended by two months to February 2022. This then delayed implementation of the full TIMCI intervention until March 2022, which was implemented in a phased manner across the three counties.
- Preparations for the TIMCI study were paused during the COVID-19 pandemic as the country focused on the national COVID-19 response and COVID-19 restrictions disrupted study planning. Local ethical approval for the TIMCI study was thus not received until October 2021, with data collection subsequently

initiated. To account for pandemic-related delays, the TIMCI project was extended from June 2023 to March 2024 (plus an ‘end of grant’ period for dissemination).

Effectiveness, Impact, Sustainability, Scalability

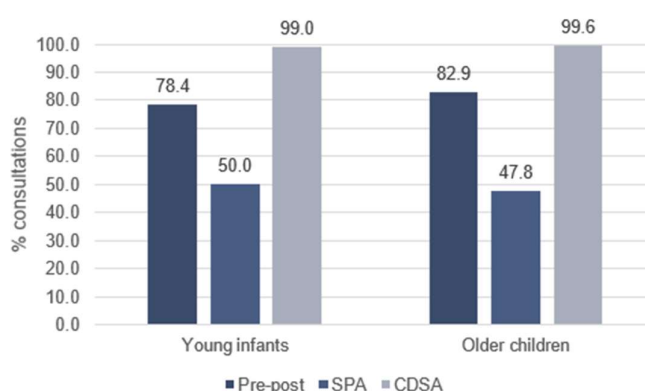
This section includes preliminary findings from the TIMCI study presented in January 2024. It does not reflect final messages on study results. As detailed in the study protocol, outcomes were assessed pre/post from 19 randomly selected facilities in the three project counties. Key results in Kenya include the following:

Pulse oximetry and CDSA were generally accepted by providers and were used in a high proportion of sick child consultations. Refer to box D.1 and figure D.1 for key findings.

Box D.1: Key findings on acceptability and use of PO and CDSA

- Both the CDSA and PO were generally accepted by healthcare providers and caregivers. Some issues raised in Kenya according to documentary evidence⁶³ included challenges to consistent use of the CDSA due to workload and availability of power in facilities (e.g. during heavy rains).
- Use of PO ranged from moderate to high, indicative of the high provider acceptability. As per review of paper-based clinical records, PO was used in 78 - 82.9% of consultations, with lower use in observed Service Provision Assessment (SPA)⁶⁴. PO use was highest when indicated by the CDSA (>99%) as this was a required data field to proceed to the next CDSA step (Figure A.1.).
- CDSA was used in 82.5% IMCI consultations (88.5% of consultation rooms had CDSA).

Figure D.1: Documented use of PO across 3 data sources⁶⁵



Overall, contrary to expectations, the study demonstrated a low prevalence of hypoxemia (SpO₂<90%) among sick children at PHC level, though with higher prevalence of moderate hypoxemia. The TIMCI intervention increased identification of ‘severe illness’ in children, but there was no detectable influence on urgent referrals or health outcomes.

- Prevalence of SpO₂<90% among sick children presenting at PHC level was below the expectations of some stakeholders (1% among children 2-59 months, and 1.7% among children < 2 months).
- Of the four study countries, levels of moderate hypoxemia were the highest in Kenya, with approximately 5-8% of children having SpO₂ of 90-91%, and 8.5-10.2% of children with SpO₂ 92-93% (attributed to Kenya’s elevation). There are some views that moderate hypoxemia is also an important clinical biomarker

⁶³ PATH (2023) Final Unitaid Narrative 2022 Annual Report

⁶⁴ The lower level of PO use (50 – 47.8%) observed through Service Provision Assessment (SPA) which were performed in a sub-set of the 19 study facilities may have been due to missed observations where PO measurements were taken at registration, where task-shifting was in place. Pre-post data source are paper-based records.

⁶⁵ STPH (2024). TIMCI IAG January 2024 slide deck of preliminary findings

in management of the sick child, however these findings were not discussed in detail with the Ministry of Health or county stakeholders who had only seen preliminary study findings by the date of this case study.

- A hypothesis for the lower than expected prevalence of hypoxemia is that the sickest children would have been treated immediately and therefore not registered in the study and/or oxygen saturation levels were not recorded, or that the sickest children would have bypassed the PHC level entirely and gone directly to higher level facilities (care seeking which bypasses the PHC level was detected by the AIRE study, also within Unitaid’s “Better Tools” portfolio).
- The intervention was found to increase detection of severe illness (2% vs. 0.9% pre-intervention), consistent with the expected influence of an intervention to improve quality of sick child assessment. However, there was **no difference in the likelihood of urgent referral** among older children compared to the pre-intervention period which is a key component of the pathway to impact. A slight increase in referrals for infants <2 mo was detected; however referral numbers were very small (n=8 children < 2 mo; 66 children 2-59 mo) and lower than the assumption at study design. The low rate of referral, based on analysis of the study findings, was considered reflective of the contextual challenges in referral systems (e.g. costs, caregiver and provider perceptions, gender based decision-making dynamics for caregivers, distance). Based on the low prevalence of hypoxemia, low overall numbers and absence of intervention impact on referrals, it is not entirely unsurprising there was **no detectable difference in caregiver reported clinical status (recovered) on Day 7** following the intervention.

The above finding notwithstanding, TIMCI has contributed to awareness and demand for pulse oximetry as a tool to improve the diagnosis of sick children at the primary level. The DNCH view CDSA+PO are valuable in the context of Kenya’s health worker shortage, with next generation devices also seen as useful in future.

- Despite the mixed study results on influence on provider practices, stakeholders interviewed shared an overall view that POs and the CDSA are valued and help take out the “guess work” by health providers. These opinions were shaped by stakeholders’ experience in TIMCI implementation, along with a review of the preliminary study results in October 2023. The DNCH have said it is a priority to make PO available at PHC and ideally next generation devices (SpO2, respiratory rate, pulse rate) in future to support rapid vital signs measurement and triage to ease the burden on overstretched health providers.
- Health officials and providers also provided anecdotal evidence in support of CDSA, for instance Kakamega county officials cited the tool had helped to identify children who were not fully immunised as immunisation history is part of the CDSA data collection. Beyond PO and CDSA, other components of the TIMCI project were also viewed as valuable. For instance, officials in Kakamega county view the clinical mentorship model developed by TIMCI as better value for money than the classroom-based 5-day IMNCI training and are applying mentorship to other child survival responsibilities.

Importantly, the CDSA contributed to a reduction in antibiotic prescribing practices, though did not significantly improve adherence to IMNCI assessment, despite stakeholders’ interest in CDSA as a tool to improve standardization in clinical care.

- Preliminary analysis of TIMCI study results found that Kenya experienced the largest reduction in antibiotic use across TIMCI study sites where use of CDSA and PO significantly reduced antibiotic prescription: by 26% for children < 2 months and by 29% for children 2-59 months. This has generated significant interest by health officials who also view this as cost-saving. Antibiotic prescription is still significant, and averages 55.1% for sick children 2-59 months (down from 84.3%), and 42% for infants < 2 months (down from 66.6%).⁶⁶

⁶⁶ STPH (2024). TIMCI IAG January 2024 slide deck of preliminary findings

- The preliminary study results also showed adherence to most of the IMNCI assessment steps did not significantly improve as a result of the TIMCI intervention (improvements were mostly where measurements are taken such as temperature and weight). This mixed picture on the effect of CDSA is indicative of the challenge of HCPs adhering to the complete IMCI algorithm (due to time constraints, and potentially other factors, pending further analysis of the study data). To a degree, this CDSA-related finding is contradictory to opinions expressed by health officials that the CDSA improves standardisation in clinical assessment.

Community mobilisation offers some promising though anecdotal results in the short implementation period.

- According to one stakeholder, implementation of community mobilisation and advocacy activities, which was contracted for one-year was in actuality implemented over a six-month period, due to need for planning time and disruptions around Kenya's elections.
- Health officials and providers spoke positively of community mobilisation and the advocacy led by the Kakamega lead CSO, and view it influenced caregivers to choose a TIMCI implementation site over another health center.
- Challenges to effective community mobilisation cited by stakeholders included sub-optimal implementation of Kenya's Community Health Strategy, transport needs from the community to health centers, long waits at health centers due to staff shortage and high demand, and lack of ambulances for referral to higher level facilities (e.g. 1 ambulance is shared between 2 sub-counties with large geographical area).

Sustainability progress

There are positive indications pulse oximetry is being adopted through various entry points in Kenya. TIMCI implementation counties have enacted several measures to support continuation of program activities after TIMCI closure.

- All three implementation counties (Kakamega, Uasin Gishu, Kitui) have reported inclusion of TIMCI activities in county annual workplans to varying degrees. Kakamega officials interviewed stated a budget has been allocated for IMCI capacity building in the annual workplan and to finance PO provision beyond the 19 project facilities. Per documentary evidence⁶⁷, Kitui county has also factored procurement of PO in the FY2023/24 workplan along with training on IMNCI and ETAT+ (Emergency Triage Assessment and Treatment plus admission of severely ill child and newborn). It is too soon to assess if this funding will continue in the next fiscal year which begins in July 2024. Whilst health officials see value in CDSA, Kakamega county officials opined it may not be economically feasible to expand CDSA to all facilities.
- At the national level, pulse oximeters with sensors for children are reported to be included within Kenya's Global Fund grant (unclear if C19RM reprogramming or grant cycle 8 funding), and these will include distribution to PHCs.
- The TIMCI design overall has supported sustainability, including the aforementioned leadership by the county health management teams, as well as integration of oxygen saturation into the health management information systems (HMIS), support in 2018/19 for revision of IMNCI guidelines to include oxygen saturation (for children with respiratory symptoms), development of clinical mentorship approach, and training on value-based procurement to promote quality in procurement of medical devices and appropriate quantification for health system levels.

⁶⁷ PATH (2023), TIMCI Kenya 2023 Annual report January 1 to June 30, 2023

The potential sustainability of the CDSA is more challenging in Kenya owing to questions of interoperability and ownership, and that Kenya is embarking on a national digital health approach that will take time to identify entry points for existing digital solutions like CDSA.

- The TIMCI server is currently hosted and managed by University of Nairobi, the local research partner, which also hosts the HMIS server. A transition plan for the CDSA and its ongoing support needs is understood to be under discussion with the Ministry of Health as part of TIMCI closure. County stakeholders expressed a desire to continue using the CDSA but said they would be limited by both cost as well as the shortages of I.T. support employed by the county.
- At the national level, an important consideration is the new focus on digital health which was not in place at the start of the TIMCI project. The government want to harmonise digital health tools and there are expectations that digital solutions will be interoperable (which the CDSA is not). Kenya’s digital health approach is considered to be an evolving strategy therefore entry points are not yet clear for the CDSA or other digital health tools and this will take time to identify. There are also privacy and patient information security considerations which would need to be taken into account.

Despite COVID-19 responses being focused on adults and tertiary care, there have been some beneficial effects overall in highlighting respiratory care needs.

- The pandemic increased awareness of health system respiratory care needs, including use of PO, and gaps in the availability of oxygen. The pandemic therefore had some ‘trickle-down’ benefits to TIMCI objectives, though some have yet to materialize. For instance stakeholders opined Kenya’s COVID-19 response was mostly focused on adults and tertiary care and documentary evidence from TIMCI reports⁶⁸ indicate that donor COVID-19 support, such as from the Global Fund did not always include PO devices, nor those appropriate for children under five years old. More recently, the recent Global Fund funding request is reported to include PO for children and at the PHC level (not clear from interviews if PO funding is through the recent GC8 funding request or reprogramming of unspent C19RM funds).

The pathway for use of hybrid study results is unclear as the project comes to a close.

- Preliminary findings from the hybrid study were not available to country stakeholders at the time of this case study. One stakeholder with knowledge of the study considered the weaker device performance in children under one year of age as a common issue in medical devices and an important gap in development of diagnostics for the youngest children where the mortality burden is highest (70% of child mortality in Kenya occurs in the first year of life). Reasons for lower performance are due to both weak mechanical fit of probes to smaller children, children are often distressed and move during assessment, along with the fact that young child vital signs can vary widely.

Overall, TIMCI’s implementation approach has fostered sustainability, with political, financing and technical aspects presenting some challenges to sustainability in project counties and expansion beyond project sites. Supporting and inhibiting factors for sustainability are depicted in table .1.

Table D.1: Sustainability supporting and inhibiting factors

Factors supporting sustainability	Factors hindering sustainability
<ul style="list-style-type: none"> • TIMCI approach of working through county health departments to implement has contributed to county ownership. Counties see value in TIMCI interventions • Evidence generation components led by national, trusted stakeholders: <i>University of</i> 	<ul style="list-style-type: none"> • Changes in leadership at the MOH, and at county level within the health departments and political level

⁶⁸ PATH (2022), TIMCI Unitaaid Narrative 2021 Annual report

Factors supporting sustainability	Factors hindering sustainability
<p><i>Nairobi (outcome evaluation); Keprecon, Nairobi County officials (hybrid study)</i></p> <ul style="list-style-type: none"> • Provision of technical support to national and county levels (e.g. value based procurement for PO and quantification) • Effective dissemination across national and project counties 	<ul style="list-style-type: none"> • Financing constraints for PO procurement and expansion of TIMCI beyond the 60 project sites • Lack of CDSA interoperability makes it difficult to scale up. Second, the GoK national aim to harmonise all digital health initiatives is a welcome advancement, though recognise this will be a slow processes and thus likely to hinder any commitments to further develop the CDSA • Shortage of county IT professionals to support CDSA/troubleshoot • Good, but limited, link with communities during project period

D.4. CONCLUSIONS, LESSONS LEARNED AND RECOMMENDATIONS

Both the TIMCI intervention package, and the implementation approach taken by PATH are perceived as highly relevant to Kenya and of promoting sustainable approaches: the former by means of aligning with Kenya’s health policy context and increased emphasis on primary care as a means to deliver Universal Health Coverage (UHC), and the latter by supporting ownership at the national and county levels and strengthening capacity to implement and sustain the TIMCI interventions. The role of pulse oximetry and CDSA in removing some of the “guess work” from the decisions of overstretched health providers has emerged as a highly valued (if less impactful under TIMCI) response to challenges faced in delivery of primary health care by providers of varying skill level working in challenging conditions.

While the effectiveness study did not demonstrate a high burden of hypoxemic children presenting to the primary care level, interviews with stakeholders confirm strong support to avail pulse oximetry at the primary care level and more widely, including with funding through the Global Fund and county budgets. This is a testament to effective in country advocacy to prioritise pulse oximetry for children, which was not prioritised during the emergency phase of the COVID-19 response.

This case study was conducted during the formulation of key messages from the TIMCI study results and prior to their national and sub-national dissemination. As such, few stakeholders could comment on the effectiveness of TIMCI evidence dissemination. The TIMCI project, pre/post study and hybrid study have generated important insights, evidence and tools supporting management of sick children, and significant work is underway to adequately interpret, package and disseminate these in the final months of the project. Some suggested opportunities and recommendations are as follows:

Recommendations for TIMCI

Ensure sub-national dissemination is adequately resourced: A challenge mentioned by many stakeholders was the turnover in several political and managerial posts during the project, and that TIMCI would need to devote additional time during the results dissemination to re-engage with new leaders. This is particularly important given Kenya’s devolved health system. Other dissemination recommendations were a desire for learning between the three project counties, and to support dissemination in neighboring counties, as a potential ‘low-hanging fruit’ for sharing lessons – both of which could be conducted pending available budget and time.

1. *Advocacy and planning for use of PO should also include outpatient units in referral facilities, to support the continuum of care in referral from the PHC level, along with requisite training and support.* It is understood that most inpatient units in referral facilities have pulse oximeters (though not always in

sufficient supply), but that these may not be available in outpatient sites. As a result, children identified as having hypoxemia and referred may be turned away from referral facilities.

2. *Ensure the hybrid study results are disseminated to key stakeholders to inform potential decisions around procurement of next-generation devices.* Hybrid study results and recommendations should be disseminated through health technical working groups and other technical and donor fora to increase the understanding of the performance of different devices and to inform potential procurement decisions within the government and by donors.
3. *Clarify with the MoH any continued support for the CDSA so that facilities already using it can continue. Communicate key learnings regarding interoperability, health provider use and other lessons to inform Kenya’s digital health strategy.* A clear plan of support for counties interested in continuing to use the CDSA should be developed. This should include requirements at the central level to manage any updates to the CDSA, and cost for technical support at the user level. It should be acknowledged that in the event there are clinical updates to the IMCI guidelines, the CDSA may then need to be updated, though no funds are understood to have been earmarked for this at present. At the global level, Unitaid could consider making elements of the CDSA ‘open access’, to support wider uptake by other platforms/ initiatives.

Additional recommendations for Unitaid based on lessons from the TIMCI Kenya case study

4. Community and civil society engagement (CCSE) “demand side” components should be adequately resourced and designed so that implementation coincides with other project components, such as facility based “supply side” investments. It is widely understood that demand generation interventions take time to influence caregiver/ target group behaviours.
5. The TIMCI consortium was well designed in that it involved national research institutions and stakeholder groups, which is important for national ownership and uptake of study findings by the government. However, stakeholders has less input on the study design as a whole, and ultimately viewed it to be overly complex. Future Unitaid investments in evidence generation could consider opportunities for greater involvement of national research partners in the study design, benefitting from their extensive experience and knowledge of local context.

D.5. KEY STAKEHOLDERS CONSULTED

Organisation	Name	Position
Ministry of Health	IMNCI Programme Manager	Dr Elsa Odira
Kakamega County	Director, Medical Services	Dr Steve Wandei
	Child Survival Officer	Dr Rose Muhanda
	Deputy Director	Dr Ruth Kapanga
	TIMCI focal point	Dr Rose Muhanda
Lurambi sub-county	Sub-county Child Health Coordinator	Dr Peter Ekesa
	Clinical Officers from Nabongo Dispensary and Elwesero Health Centre	

Organisation	Name	Position
Matunda Jua Kazi Civil Society Organisation (Kakamega County)	Director	Meshack Lupele
University of Nairobi	TIMCI study coordinator	Francis Njiri
	TIMCI study team	Jackie
	TIMCI study team	Kevin
Keprecon	PI for Hybrid study	Prof Ambrose Agweyu
WHO	Child, Adolescent Health and Nutrition Officer	Dr Shiroya Makeba
PATH	TIMCI Project director	Andolo Miheso
	TIMCI Program officer	Janet Shauri
	TIMCI Advocacy and public policy lead	Clayton Opiyo
	TIMCI M&E officer and CDSA lead	Dickens Omedo Ochuka
	Source Project Director	Helen Kamau

D.6. REFERENCES

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PATH TIMCI Kenya 2023 Annual report January 1 to June 30, 2023

STPH (2024). TIMCI IAG January 2024 slide deck of preliminary findings

Kenya DHS (2022), <https://dhsprogram.com/pubs/pdf/PR143/PR143.pdf>

Appendix E **SENEGAL CASE STUDY**

This appendix presents the summary findings from the country case study on Senegal which was one of the TIMCI implementation countries. It has been developed based on (i) virtual consultations with national stakeholders (Section E.2.6 includes a list of consultees); and (ii) a review of documentation and data.

The Senegal case study was conducted over 26 February to 8 March 2024, **prior to formulation of key messages from the final TIMCI study results** and their dissemination at national and sub-national levels. This dissemination was planned to take place during March and April 2024.

E.1. COUNTRY CONTEXT

Senegal, located in West Africa, has a population 17,316,449 people (as of 2023) of which 15% are estimated to be under the age of five.⁶⁹ Over the last decade, the country has made significant progress in reducing child mortality with a reported under five mortality of 39 per 1000 live births in 2021 against 134 in 1990.⁷⁰ Still, the majority of under-five deaths in the country remains preventable and could be avoided with the right care and access to timely medical services.

The Senegalese health system is organised through a pyramidal structure with three levels of care comprising hospitals as the highest level of care, health centres and, finally health posts providing primary care. The administration of the health sector is also structured along three levels, a central level represented by the Ministry of Health and Social Affairs (MOHSA), an intermediate/regional level (representing the 14 regions) and a peripheral (representing 77 health districts).⁷¹

General government expenditure on health has recently increased and reached 6.48% in 2020 (as % of total government expenditure) after a constant downward trend since the early 2000⁷², yet it still remains far less than the recommended 15% from the Abuja declaration⁷³. This government expenditure represents only 33% of current health expenditure against 41.5% paid in out-of-pocket expenditure. The health system has historically been very hospital-centred, with hospital estimated to account for two thirds of public funding in 2013.⁷⁴ And whilst the majority of health care facilities (71%)⁷⁵ are managed by the MOH, access to services has been increasingly delivered by the private sector especially in urban areas where it is estimated to represent nearly 70%⁷⁶ of the total provision of health services.

⁶⁹ ECD (2023). Early Childhood Development country profile: Senegal. Countdown to 2030, 2023 updates.

⁷⁰ World Bank (2024). Mortality rate, under-5 (per 1,000 live births) - Senegal

⁷¹ Elisabeth Paul et al (2020). An assessment of the core capacities of the Senegalese health system to deliver Universal Health Coverage

⁷² Government financing for health as % of total government expenditure was 9.05% in 2003 before reaching its lowest point at 4.37% in 2019.

⁷³ World Bank (2024). Domestic general government health expenditure - Senegal

⁷⁴ Elisabeth Paul et al (2020). An assessment of the core capacities of the Senegalese health system to deliver Universal Health Coverage

⁷⁵ PHCPI (2022). Primary Health Care Performance Initiative – Senegal.

⁷⁶ Elisabeth Paul et al (2020). An assessment of the core capacities of the Senegalese health system to deliver Universal Health Coverage

E.2. UNITAID COUNTRY SUPPORT

Senegal is one of the four countries⁷⁷ where the TIMCI project was implemented along with Kenya and Tanzania (in West Africa) and the Uttar Pradesh state in India (Asia). In Senegal, the TIMCI project was implemented in the Thies region across 60 implementation facilities (health posts) supported by 5 referral facilities. The project is led by PATH, in partnership with the national Ministry of Health and Social Action (MOHSA) and the Université Cheikh Anta Diop de Dakar in Senegal (UCADD) as its local research partner. The goal of the main objectives of the TIMCI project are:

- To improve the ability of healthcare providers (HCP) at the PHC level to diagnose moderate to severe disease by equipping them with pulse oximeters (PO) and a tablet-based clinical decision support algorithm (CDSA); and
- To accelerate the development and market entry of non-invasive devices that augment the features of standard PO with one or more additional vital sign measurements.

In support of these objectives, TIMCI included two research components in Senegal:

- i. A quasi-experimental pre-post study to evaluate the cost-effectiveness of PO and CDSA on clinical & quality of care outcomes and understand mechanisms of and facilitators & barriers to implementation.⁷⁸
- ii. A field-based mixed methods effectiveness-implementation study measuring the performance and feasibility of multimodal pulse oximeter devices by primary care providers.⁷⁹

The TIMCI implemented the following activities in Senegal:

- Procurement and introduction of POs and CDSA in intervention facilities. POs were procurement along with essential equipment and medicines to project facilities to ensure necessary treatment commodities would be available. This also included providing oxygen and related equipment to referral health centers and implementation facilities. Procurement was facilitated through the MOHSA, UNICEF and other relevant partners (e.g., National Supply Pharmacy, Air Liquid), and supplies were integrated into existing national supply chain systems to prevent creating an unsustainable parallel system.
- Training of health care providers on “IMCI Plus” (IMCI + PO), including specific components on the use of IMCI, PO and the CDSA. A post-training follow-up and two supportive supervisions were conducted under the supervision of the Direction de la Santé de la Mère et de l'Enfant (Directorate of Maternal and Child Health), or DSME, allowing for necessary reorientation and consolidation of knowledge after initial training, and especially after long period of national strikes.
- Review and update of the supportive tools, relevant policies and guidelines, to include the use of PO for children, oxygen use for children in treatment, and documentation on drugs and commodities.
- Community and civil society engagement (CCSE) was conducted with a range of civil society organizations (CSOs) and community health workers (CHWs) to increase awareness and understanding of care-seeking, screening, diagnosis, and referral processes at primary health care facilities.

⁷⁷ The TIMCI project was initially planned to be implemented in 5 countries but the project was ended in Myanmar in 2021 due to coup a political Myanmar.

⁷⁸ The pre-post study was conducted in collaboration with the global study partner Swiss Tropical and Public Health Institute (STPH)

⁷⁹ Due to technical and connectivity issues, Senegal only conducted the implementation study and not the accuracy study as was done in other TIMCI countries. STPH (2024). TIMCI IAG January 2024 slide deck of preliminary findings

E.3. KEY FINDINGS

Relevance and coherence

The TIMCI project demonstrated strong relevance with the country context and alignment with existing efforts from national and global partners to strengthen PHC, integrated management of childhood diseases and access to essential pneumonia treatment including oxygen. The TIMCI project came at an opportune time and in a context where strengthening health systems through primary health care systems, was at the forefront of the national health agenda.

- Over the past decades, Senegal has been making comprehensive efforts to improve equitable access to health services through a primary health care approach and reach universal health coverage (UHC). In 2013, the government launched an ambitious Universal Health Insurance (Couverture Maladie Universelle, CMU) to increase access to healthcare for key target populations including women and children and people from low socio-economic background. This also included the launch of a national policy for free access to services primary level for children under five.⁸⁰
- With Pneumonia being the second leading cause of child death in the country⁸¹, timely detection and treatment of the disease has been a key priority on the national agenda. To enhance effective management of childhood diseases, IMCI has been adopted in the country as a core element of the national strategy for reducing child mortality and received increased support from donors over the last decades. It is also reflected as a key approach in recent national investment cases such as the country 2018 Global Financing Facility (GFF) investment case.⁸²
- Efforts for expanding access to essential pneumonia treatment and tools (including oxygen and related devices such as pulse oximeters) have been made in the country over recent years through domestic financing as well as donor funding. This include a \$14 million USD investments in domestic funds made by the Senegalese Ministry of Health and Social Action (MOHSA) before the TIMCI project to build oxygen generation plants in 35 hospitals and scale access to oxygen across the country.⁸³ Global partners had also been supporting these efforts with additional investments, notably UNICEF through its Scaling Pneumonia Response Innovations (SPRINT) Programme launched in 2018, with the aims to expand access pneumonia treatment including oxygen therapy, antibiotics and supporting devices such as POs.⁸⁴

Throughout the project, the implementers ensured effective engagement of stakeholders and integrated TIMCI interventions within existing systems to maximise coherence and synergies. The project reported regular engagement between the project team and stakeholders including national authorities, wider in-country stakeholders and key global partners from the onset of the project and throughout its implementation to strengthen interventions relevance and enhance alignment.

- **This includes having regular meetings, workshops and wider engagement with national authorities at central and subnational level** through the Ministry of Health and Social Action (MOHSA), Direction

⁸⁰ The World Bank (2019). Senegal Investing in Maternal Child and Adolescent Health project appraisal document. <https://documents1.worldbank.org/curated/en/469001569808857911/pdf/Senegal-Investing-in-Maternal-Child-and-Adolescent-Health-Project.pdf>

⁸¹ Ba, EKC (2020). Inequalities in child survival in a rural area of Senegal where malaria incidence has declined. LSHTM Research Online. London School of Hygiene & Tropical Medicine. DOI: <https://doi.org/10.17037/PUBS.04657744>

⁸² The Government of Senegal (2018). Investment Case to the Global Financing Facility for reducing in maternal, child and adolescent mortality. <https://www.globalfinancingfacility.org/sites/default/files/2022-12/Senegal-dossier-dinvestissement.pdf>

⁸³ PATH (2019). TIMCI project plan

⁸⁴ UNICEF (2024). The Scaling Pneumonia Response Innovations (SPRINT) Project. <https://www.unicef.org/innovation/productinnovation/SPRINT>

de la Santé de la Mère et de l'Enfant (DSME), IMCI unit, Direction des Infrastructures, des Equipements et de la Maintenance (DIEM), Joal district officials etc. This enabled the project to benefit from existing political interest on this issue and keep PO at the forefront of the national agenda throughout the project period. The TIMCI team was also part of relevant technical working groups (TWGs) including the national reproductive, maternal, newborn, and child health (RMNCH) steering committee. This provided an opportunity to contribute to shaping national guidelines early on whilst benefiting from national technical expertise in the TIMCI project.⁸⁵ The project also ensured active engagement with relevant global partners. In particular, the project team worked closely with UNICEF in Senegal, recognising the overlap between the TIMCI project and the existing UNICEF SPRINT programme, to promote synergy between the two initiatives and foster alignment between their methods and activities including training, monitoring, sustainability and scalability efforts.⁸⁶

- **The project activities were streamlined and integrated into existing health systems and processes to minimise duplication and fragmentation of service delivery.** This includes embedding training, supervision and monitoring activities in existing national processes, and integrating procurement and supplies into the existing MOHSA storage and supply chain systems, in collaboration with the National Supply Pharmacy, Direction des Infrastructures, des Equipements et de la Maintenance (DIEM) and UNICEF. The project advocacy and engagement plans were also validated and implemented with relevant authorities including the MOHSA Directorate of Maternal and Child Health (DSME), the Thiès Medical Region, and the MOHSA Community Health Unit.
- **By partnering with a local research partner and engaging communities and civil society organisations, the project strengthened its alignment with local and contextual needs.** The project partnership with the Centre d'Excellence Africain pour la Santé de la Mère et de l'Enfant (CEA-SAMEF) hosted by the Université Cheikh Anta Diop de Dakar in Senegal (UCADD), promoted a locally led research approach in the project and enabled it to benefit from the credibility and contextual knowledge of renowned local research partners. The project also ensured an inclusive engagement of civil society and communities by working with various CSOs (e.g., Croix-Rouge de Mbour, Association des Badienes Gox, Association des Relais Polyvalents de Tivaouane, Association des Acteurs Communautaires de Fissel pour la Promotion de la Santé etc.) as well as community health workers and community leaders, to increase the relevance and efficiency of awareness raising and advocacy activities. CSO advocacy and capacity-building workshops were done in collaboration with the national stakeholders (e.g., DSME, MOHSA Community Health Unit).

The CDSA component and hybrid studies on next generation devices were also seen as relevant in the context of Senegal. Stakeholders welcomed the intervention CDSA and hybrid study components as they promoted the use of digital tools and innovations to strengthen healthcare services in the country which is aligned with current national interests.

- In particular, national stakeholders showed a keen interest in the use of the CDSA in Senegal and its potential benefit to improve treatment decisions including reducing unnecessary antibiotic prescription and mitigate antimicrobial resistance (AMR).⁸⁷ This project reported that the government of Senegal was already implementing various global health security projects focused on AMR and as such, the project CDSA findings could provide beneficial evidence to support wider national efforts in that space. However, we note that stakeholders flagged a lack of pre-existing digital ecosystem in which to embed the CDSA component at the start of the project which as a result had to be designed as a standalone tool.

⁸⁵ PATH (2021, 2022, 2023). TIMCI annual project reports.

⁸⁶ PATH (2022). TIMCI annual project report.

⁸⁷ PATH (2022). TIMCI annual project report.

- The project intervention using next generation devices in Senegal was mainly done through the hybrid study. Stakeholders shared being interested in the potential of multimodal devices (e.g., integrating PO and respiratory rate (RR)) to strengthen healthcare practices and support more accurate diagnosis at country level.

Efficiency

The project faced a number of challenges that impacted implementation and timeliness of the project activities including “external” factors such as the COVID-19 pandemic and a national HCWs strike, and “internal” factors related to the design of the CDSA components.

- **The COVID 19 pandemic was a key challenge globally and lead to major delays in planned activities.** During acute lockdown phases, engagement with government ministries, research partners and other stakeholders was limited. Other key activities such as procurement were also highly impacted as a result (i.e., final orders of commodities and supplies were only delivered to facilities in 2022). Due to movement restrictions and countries’ focus on COVID-19, the pre-post study was delayed by over six months and started around July 2021.⁸⁸
- **The project also reported the impact of the pandemic on communities' care-seeking patterns which resulted in lower numbers of children presenting in health care facilities.** As recruitment was lower than expected, the decision was taken to extend data collection to March 2023 to allow the longitudinal target sample size to be reached.⁸⁹ This was reflected in the project logframe and Gantt chart to adjust the project timeline accordingly.
- **Another main challenge flagged during the implementation was the ongoing healthcare workers (HCWs) strike which significantly impacted the use of CDSA** in the implementation facilities. This led to irregular use of the tool and poor data retention (absence of CDSA data synchronization) during the study. This strike also impacted other activities including supervision and training of HCWs.
- **Inherent challenges to the project further exacerbated delays in the pre-post and hybrid studies research timelines. Notably, the project reported challenges in adapting the CDSA algorithm to local clinical guidelines** and flagged a security breach issue which led to suspension of the CDSA use in pilot health facilities, further delaying the implementation of activities.⁹⁰ With regards to the hybrid study, delays were mostly due to the MOHs’ slow distribution of the devices to facilities and the need for approval from global Research Ethics Review Committees (e.g., WHO ERC). Data collection for the hybrid study was only initiated in Senegal in 2022.⁹¹

Effectiveness and Impact

Overall, the study results reported a good acceptability of PO and CDSA based on qualitative feedback and demonstrated the added value of CDSA in supporting better clinical practices. However, results on the effectiveness of the intervention in identifying hypoxemic cases at PHC level were more reduced. The studies also reported less than 50% adherence to using the CDSA and PO in project facilities though this was largely due to contextual challenges. The majority of stakeholders interviewed reported that the PO and CDSA tools were well accepted and shared anecdotal stories of caregivers requesting the use of CDSA on their children as a sign of better quality of care. These feedback were aligned with the research results which reported

⁸⁸ PATH (2020). TIMCI GPU-GBO. Version of 24May2020

⁸⁹ PATH (2022). TIMCI annual project report.

⁹⁰ PATH (2022, 2023). TIMCI annual project reports.

⁹¹ Baseline data collection was conducted in 2021 ahead of the study start in 2022. *PATH (2021, 2022). TIMCI annual project report.*

many perceived benefits from using the CDSA and PO by providers and caregivers including a perceived improvement in quality of care and perceived added value of CDSA in supporting better assessment, diagnosis, treatment and management.⁹² According to the study, HCPs also shared that the CDSA tool helped promote better referral decisions, although no effect on referral was reported from quantitative analysis of the study.

- **A key finding of the study was that it demonstrated the added value of CDSA in supporting a reduction of unnecessary antibiotic prescription.** National stakeholders found these results very valuable and encouraging seeing existing efforts in the country to improve antibiotics prescription practices and reduce AMR. However, we note that the reported reduction in antibiotic prescription in Senegal was lower than other countries (e.g., and -16.7% for infants 0-2months and -14% for children 2-59months in Senegal against -25.7% for infants 0-2months and 29.1% for children 2-59months in Kenya).⁹³ Additional analysis on the TIMCI study results were ongoing at the time of this case study which may help identify the causes of this difference and help better interpret these results.
- **The study results reported an adherence to using pulse oximetry at 42.6% in project facilities (44.7% for children between 2-59 months and 40.5% in children under 2 months of age) and 40.5% adherence for using CDSA on enrolled children.**⁹⁴ Whilst a full interpretation of the study results was not yet available at the time of this case study, stakeholders flagged that the HCPs strike impacted the use of both tools in project facilities (as providers abstained from using the tools during the strike) which may explain these results. Other challenges to using the tools were also reported as part of the study:
 - For instance, the research reported that the use of CDSA noticeably increased consultation time especially when used for the first time which may present an additional deterrent especially during busy period. The study also reported that familiarity with using the CDSA improved this issue as providers practice progressed.
 - HCPs also flagged some difficulty in using PO and obtaining measurements particularly in very young infants. This may also act as a barrier to consistently using PO in facilities especially in busy settings such as large health centres and emergency settings.
- **The prevalence of hypoxemia cases reported in project facilities was low, which stakeholders suggested may be due to the influence of wider contextual factors.** Overall, the reported prevalence of hypoxemia was lower than expected across project facilities (0.8% for severe hypoxemia SpO₂ < 90%; 0.2% for SpO₂ between 90% to < 92% and 1.2% for SpO₂ between 92% to < 94%).⁹⁵ In light of these results, stakeholders suggested that various cofounders may have limited the intervention ability to identify hypoxemic children at PHC level earlier in the healthcare pathway. For instance, the sickest children may have potentially bypassed primary care level to go directly to a hospital (as is common in many settings). Stakeholders also highlighted the potential influence of the pandemic on communities' care seeking behaviour as people were encouraged to stay at home and avoid public travel. Further data analysis and disaggregation of the research data would help better understand the impact of these factors amongst others on the study and identify which children would benefit most from being assessed with a PO at PHC level to maximise patients outcomes and chances of child survival.

Despite these results, the project led to significant progress in the policy landscape in the country, facilitated by a pre-existing appetite from the government in that direction. According to stakeholder

⁹² STPH (2024). TIMCI IAG January 2024 slide deck of preliminary findings

⁹³ STPH (2024). TIMCI IAG January 2024 slide deck of preliminary findings

⁹⁴ STPH (2023). TIMCI Cross-country quasi-experimental pre-post study: Final Statistical Analysis Report (Kenya and Senegal)

⁹⁵ STPH (2023). TIMCI Cross-country quasi-experimental pre-post study: Final Statistical Analysis Report (Kenya and Senegal)

feedback, the project significantly contributed to encourage proactive decision making on policy changes to integrate PO in national policies and guidelines. This was due to a large extent to an existing appetite from the government to integrate PO as part of IMCI guidelines as well as an existing fertile environment in the country (as described previously), which largely benefited the project. As a result of these concerted efforts:

- The national IMCI booklet was revised in 2021 to include recommendations on using pulse oximeters and oxygen therapy. In 2022, national norms and protocols on child health were also revised to integrate recommendation on the use of PO and the tool was included on the national essential device list (carte de sante).⁹⁶ Relevant training tools and supportive guideline were also updated, notably the national maternal, newborn, and child health (MNCH) supervision documents which have been updated based on the project supervision template.⁹⁷
- The TIMCI team worked with the government to strengthen their procurement tools⁹⁸ which defines the technical specifications for POs adapted for PHC level and guidance for use on adults, children and newborns. This technical guidance will enable better decision making from national supply chain actors and technical and financial partners during the procurement, distribution and use of pulse oximeters.
- Key indicators from the project (e.g., SpO2 measurement, number of hypoxemia cases and number of referred cases) were also integrated in the DHIS2 and have been adopted in the 60 projects facilities to strengthen IMCI and child health M&E. The paper-based format of the monthly IMCI-plus manual used in the project was also made available in health facilities.

The hybrid studies enabled the project to document evidence on the feasibility of introducing next generation POs at the PHC level, and increased stakeholder awareness in that regards. Stakeholders reported that the knowledge on the feasibility of introducing approved next generation PO at the PHC level, could help encourage demand for these multimodal tools and accelerate the adoption of this innovation instead of basic POs. However, it is still unclear if these results on their own would be enough to influence donors and manufacturers and could lead to demand, financing or supply of next generation POs. Though we highlight that the dissemination of the hybrid study results was still pending at the time of this case study and limits an assessment in that regards.

The CCSE interventions served a similar purpose in that they enabled better community awareness of the project's interventions at the time of its implementation. The project included a wide range of interventions as part of its CCSE approach including a combination of engagement and outreach activities such as in-person events (talks, social mobilizations, awareness-raising session in the health posts), radio shows, and engagement of community leaders and champion, as well as home visits in communities. The project also reported that CCSE interventions which were originally planned to end in October 2022, were extended for an additional 6 months to align with the study timeline and ensure continued awareness raising throughout. Whilst there was limited evidence overall on the effectiveness of these intervention to improve health seeking behaviours in communities, some stakeholders shared they nonetheless contributed to encourage communities acceptance of the project interventions during its implementation.

⁹⁶ PATH (2022). TIMCI annual project report

⁹⁷ PATH (2023). TIMCI annual project report.

⁹⁸ Guide national d'approvisionnement en oxymètres de pouls. September 2022.

Sustainability and Scalability

The government of Senegal expressed its commitment to promote access to oxygen and PO adoption at all levels of care including at PHC level. The project has also been engaging with stakeholders to identify opportunities for further PO procurement and financing. However, sustainable procurement of PO remains uncertain seeing the lack of predictable funding and dependence on donor financing. The project reported working with national and global partners to identify relevant opportunities for further PO procurement in line with the government commitment to increase access to oxygen and PO across all levels of care including PHC level.

- The TIMCI team is exploring opportunities to integrate PO procurement as part of national funding requests and investments cases such as through the Global Fund COVID19 Response Mechanism (C19RM) or Global Financing Facility investment case. It also reported identifying potential opportunities to leverage the results and lessons learned from TIMCI in other relevant projects to support PO procurement as part of oxygen roadmaps. This include for example through the ongoing Strengthening Oxygen Utilization and Respiratory Care Ecosystems (SOURCE) project funded by the BMGF which is being implemented in several TIMCI countries including Senegal and led by PATH.
- The project had initially considered developing scale-up plans, however, in light of the study results, they shared the intention to pivot to documenting and disseminating lessons learned from the project.
- However, there was no indication that PO procurement could be sustained through domestic funding and wide recognition that PO procurement in the country would remain highly dependent on donor financing at least in the short to medium term. Therefore, in the absence of more predictable funding sources, the sustainability and scalability of PO procurement especially for peripheral facilities and primary care remains challenging especially in a funding constrained environment with multiple competing priorities.

National stakeholders also showed a keen interest in sustaining the CDSA tool especially in light of the study results. However, the sustainability and scalability of the tool remains unclear due to challenges in integrating the tool in national digital systems and limited visibility on resources to maintain it beyond the project. In 2023 the DSME and agency responsible for digitalizing the health system were identified as lead entities to drive the transition and scale-up of the CDSA tool in collaboration with other relevant technical services in the MOH. The integration of scale-up activities as part of the existing Community Health Digitization action plan was also being discussed. However, the CDSA as currently design presents multiple challenges to be sustained.

- In particular, because the CDSA was created as a standalone tool at the beginning of the project, it is still unclear whether post-project integration will be possible due to interoperability issues, especially as the digital health ecosystem in Senegal is still nascent. At the end of 2023, the project CDSA server was still hosted by PATH and transition arrangements were being discussed with the government.
- Beyond the availability of a digital ecosystem ready to integrate this tool, the successful integration and transition of the CDSA would rely on prerequisites resources which are not necessarily available currently. This includes adequate human resources and technical capacity to manage and maintain the tool as well as wider financial resources to procure digital devices, implement wide scale straining and effectively scale the tool across the country.

E.4. CONCLUSIONS AND LESSONS LEARNED

The TIMCI interventions were seen as highly relevant in the context of Senegal seeing the alignment of the project interventions with existing national priorities and ongoing investments at country level. As a result, the project was able to benefit from a fertile environment to implement its interventions in Senegal and was able to leverage the interest of national stakeholders and synergy with existing initiatives to accelerate policy change and reforms for introduction of PO.

In addition to these operational gains, the project also provided the opportunity to document key evidence and lessons learnt on of feasibility and effectiveness of adopting PO and CDSA at PHC level in the country. Notably, the TIMCI study demonstrated the added value of CDSA in promoting better clinical practices around antibiotics prescription, which national stakeholders found very beneficial. On another hand, the study results reported mixed results in the capacity of the intervention (as designed) to lead to better management of hypoxemic and severe cases, as number of hypoxemic cases at PHC level was low overall and management of hypoxemia even when diagnosed was dependent on referral uptake and availability (or lack) of treatment in higher levels of care (e.g., oxygen) which were outside the scope of this project. The reported adherence with using the tools at PHC was also mitigated during the project (due mainly to contextual challenges) which does not provide the possibility to infer on what adherence would be under normal circumstances.

Beyond these results, national stakeholders have shared a strong commitment to drive PO adoption across all levels of care including PHC level and the project has identified several opportunities to integrate PO procurement as part of existing partner investments, in the short to medium term. However, the dependence on donor funding and lack of more predictable financing source may hinder long term sustainability. Despite a keen interest to keep the CDSA tool beyond the project, the sustainability of tool also remains unclear due to limited visibility on necessary resources to sustain and scale it beyond the project including a lack of required digital infrastructures as well as financial and human resources.

In light of these findings, some suggested opportunities and recommendations are as follows:

- *Carefully analyse available data from the study to identify key lessons learned and support national and global stakeholders in appropriately interpreting the study results:* In light of the mixed results from the pre-post study, stakeholders advised careful analysis and dissemination of the study results to ensure that the conclusions and lessons learnt from this study are appropriately interpreted and can be best leveraged in future interventions. In addition, a number of findings would benefit from further analysis and disaggregation to clearly identify and understand the influence of confounding factors on the intervention.
- *Leverage the diversity of findings provided in this portfolio to allow a more comprehensive picture of the interventions results during dissemination.* A strong benefit of this portfolio is that it offers a wide range of findings both across TIMCI countries and between the AIRE and TIMCI studies. This provides a good opportunity for TIMCI to highlight complementary findings across contexts and leverage lessons learnt across the portfolio to present examples of best practices (what worked well) and pitfalls (what worked less well) and support informed decision making.
- *Advocate for PO procurement interventions to be designed in a whole of systems approach to maximise the effectiveness of future investments, especially at PHC level:* As TIMCI continues to support national stakeholders in identifying opportunities for PO procurement, it is essential that they encourage PO procurement to be integrated as part of a package of care with the required supportive systems and enabling conditions in place. This includes, but not limited to, ensuring access to oxygen to treat hypoxemic cases, strengthening referral systems, improving HCPs capacity through training and supporting supervision amongst other considerations.
- *Support countries and global partners in interpreting the CDSA results and identifying areas for future research and/or conditions for adoption in the country context.* The study results on CDSA have highlighted the potential benefit of using the tool to support better quality of care and prescription practices at PHC level, which is highly relevant in the context of Senegal. However, the challenges reported regarding interoperability issues with the tool as currently designed, as well as the lack of necessary capacity, resources and digital systems to sustain it going forward, call for further information on how to best adapt it in the country context. A such, future implementation research is encouraged to provide additional proof of concept examples and inform decision making in that regards. In the meantime, the TIMCI team and relevant authorities, are encouraged to explore the algorithm as designed from this project could be integrated in existing systems and how to facilitate its transition and sustainability.

- *Ensure the TIMCI hybrid study results are disseminated to the right audience and through the right medium, along with other TIMCI market shaping outputs, to enhance their uptake and utility:* This includes by identifying which audience would benefit most from each component of the study results, ensuring that the findings are packaged in an accessible format, and delivered to the appropriate audience through a wide range of communication channels. There is also an opportunity to disseminate these study findings along with previous information from the market shaping outputs under the TIMCI project (e.g., TPP, product landscape) to provide a more comprehensive package of information on next generation devices to national and global stakeholders.

E.5. LIST OF STAKEHOLDERS INTERVIEWED

Table A.2: List of country level stakeholder consultees for Senegal

Organisation	Name	Position
PATH country team	Maymouna Ba	Project lead
MoH	Dr Mbodj	IMCI Unit head DSME (MoH)
MoH (district level)	Dr Saliou Ndoye	Head of Joal District
MoH (responsible for oxygen systems/O2 roadmap)	Raphael DIEM	TIMCI Focal point at the DIEM (MoH)
CEA SAMEF	Professor Ousmane	Principal Investigator
CEA SAMEF	Professor Moctar	Co-Principal Investigator
Croix Rouge Mbour	Mr Mamadou Diop	Head of CSO Croix Rouge Mbour
Poste de santé	Babacar Ndour	Head nurse/Ngueniene site

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