ACTION AGAINST HUNGER

SERIES
INNOVATION FOR ACTION

SAM PHOTO APP
REVOLUTIONIZING NUTRITIONAL DIAGNOSIS

NO DIAGNOSIS, NO TREATMENT

13.6 million children are undernourished worldwide, and of these, those with severe acute malnutrition (SAM) are 10 times more likely to die[1]. Despite efforts to improve access to nutritional treatment, **only one in five undernourished children access treatment (20%).** One of the main underlying factors behind this phenomenon is the lack of a rapid, easy and accurate diagnostic method that would allow early detection of malnutrition and, with it, access to the necessary treatment.

The usual equipment for nutritional diagnosis (measuring rod for height, scales for weight and MUAC tape for upper arm circumference) has not evolved in decades and is difficult to transport and maintain in adequate conditions at the community level. Also, the World Health Organisation reference tables are difficult to decipher for some health workers or others with low literacy skills. This leads to a high number of misdiagnoses of child undernutrition.

The problem, therefore, is threefold:

1 Operational. The limited reliability of existing diagnostic methods for child undernutrition and the paucity of reliable data make understanding the problem a complex task. Epidemiological surveillance systems based on paper reports have limited effectiveness in identifying and responding adequately to emergencies.

2 Structural. The insufficient availability of health centres and trained personnel, as well as geographical, security and climatic barriers that limit the accessibility of health services for families, means that nutritional diagnosis depends in part on community health workers. In addition to the difficulty in accurately capturing anthropometric indicators (height, weight) in children, the work overload of these agents reduces the frequency of screening, thus limiting early detection and, with it, access to treatment.

3 Technological. Motivated by the scarce digitalisation of the diagnosis of child malnutrition and the limited access to internet in health centres.

CHANGING THE LANDSCAPE

What if a smartphone camera could save lives?

Having **a tool that enables early identification of child malnutrition from a smart phone** can be one of the modern keys to combating malnutrition and hunger around the world. The widespread availability and accessibility of mobile phones today is the best ally for our vision. The world has witnessed how technology has substantially transformed almost every aspect of daily life in recent years. From communication to mobile money, digitalisation has advanced by leaps and bounds, positively transforming our daily lives. By the end of 2025, it is estimated that the number of mobile devices will reach 18 billion.[2]

In this scenario, the **SAM Photo App,** developed by Action Against Hunger, is positioned as a revolutionary digital tool capable of diagnosing child malnutrition with just a photo of the child's left arm. In addition to the innovative methodology applied, thanks to its ease of use and comprehensive approach, **SAM Photo App** offers:

1. Rapid identification that saves lives

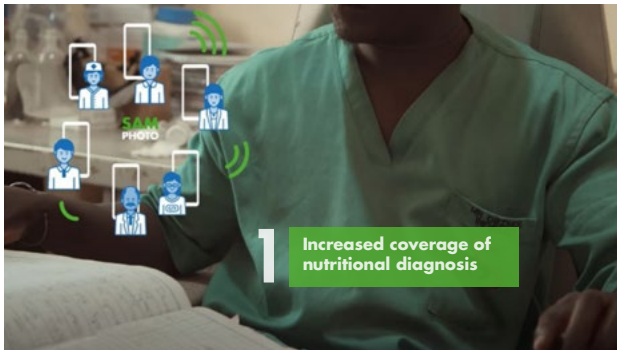
Increased coverage of nutritional diagnosis

This innovative tool, backed by rigorous published scientific research, has the ability to **detect acute child malnutrition with a simple digital photo-**

[1] Levels and trends in child malnutritionUNICEF / WHO / World Bank Group Joint Child Malnutrition EstimatesKey findings of the 2023 edition https://www.who.int/publications/i/item/9789240073791

[2] Mobile Statistics Report, 2021-2025 de The Radicati Group. Link: The Radicati Group, Inc. » New Announcements Reports » Mobile Statistics Report, 2021-2025

graph of a child's left arm taken with a smartphone. Without diagnosis there is no access to treatment. **SAM Photo App** facilitates nutritional screening by providing health workers with a reliable and easy-to-use application for early detection of acute malnutrition in children under five years of age.



2. Quality nutritional data for decision making

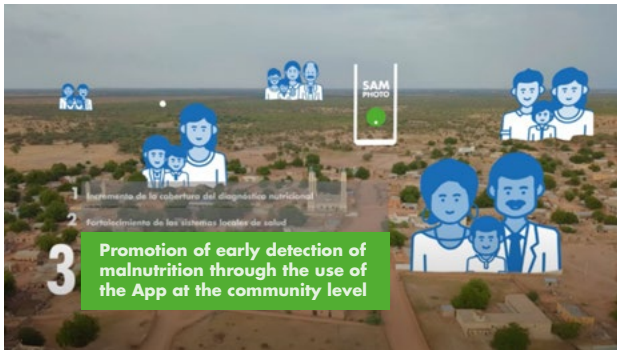
Strengthening local health systems

SAM Photo App ensures the **collection of accurate and reliable data on child undernutrition,** optimising the use of human and financial resources.

3. Engagement with communities

Promoting early detection of malnutrition

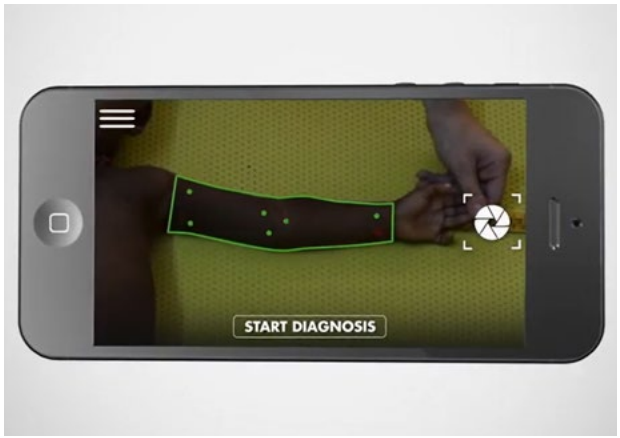
SAM Photo App promotes the participation of communities in nutritional identification and treatment, improving coordination between health centres and families.



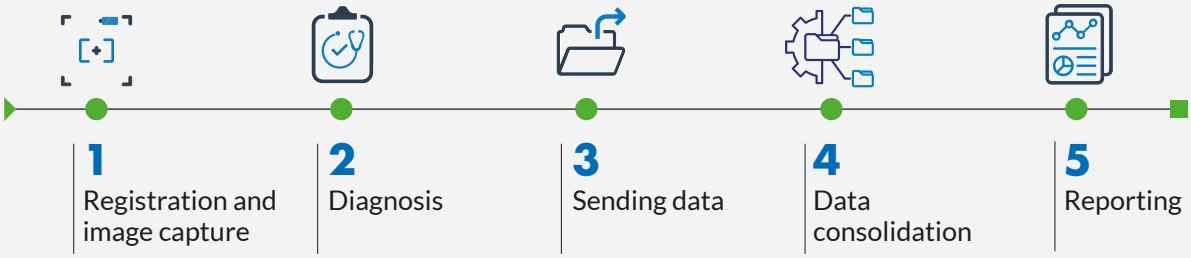
HOW DOES SAM PHOTO APP WORK?

The methodology behind SAM Photo App

SAM Photo App's ability to detect malnutrition is made possible by geometric morphometry, a multidisciplinary set of techniques that allows the visualisation and quantification of differences in the shape of organisms. It is a method widely used in biology to describe morphological differences between species and in forensic medicine to identify human remains.

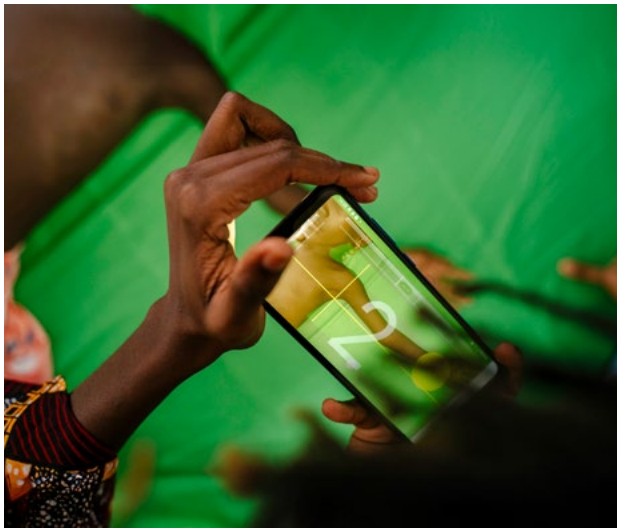


FROM IMAGING TO DIAGNOSIS

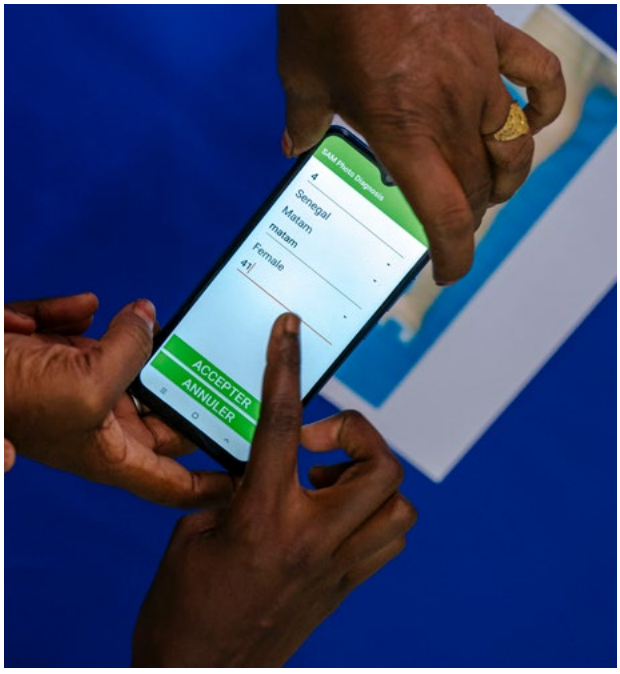


The mobile application: Diagnostic image acquisition

The image-taking process is intuitive. A person takes a picture of the child's left arm with a smartphone, without the need for an internet connection. The app evaluates the digital image, determining the nutritional status through a previously validated algorithm. The person recording data with the **SAM Photo App** receives detailed information about treatment options in their area.



The web application: storage and processing



Once analysed, the photo image is automatically deleted, saving only the anonymised image data required for diagnosis on the mobile phone. When an internet connection is available on the phone, the anonymised data, collected and stored on the mobile phone, is uploaded to the **SAM Photo App** web platform. From this web platform users can visualise and analyse the collected data from a public health perspective, allowing authorities to make use of the data to make better decisions.

APPROACH TO THE WORK PROCESS

1. BUILDING THE SCIENTIFIC FOUNDATION

a. Geometric morphometry: a method for describing the shape of the infant human body. A 2D model of homologous anatomical landmarks was designed to optimally record the shape of the child's body, including the main muscle and adipose bundles, showing the changes that a differential nutritional condition entails, as well as the bone structure, which is highly representative of the type of growth a person undergoes. Studies showed that geometric morphometry could identify the changes that girls' and boys' body shape undergoes during growth.

b. Geometric morphometry used to detect acute malnutrition in children. We also demonstrated that the technique allowed us to detect and isolate the changes that occur in the shape of the body in the presence of severe acute malnutrition, with the greatest precision being shown in the left arm. Based on these characteristics, we established a classifying algorithm that allows us to distinguish between a healthy case and one with this type of malnutrition.

c. Creating SAM Photo Diagnosis App. The next challenge was to integrate all this methodology into an Android mobile device, with the aim of creating an App that was easy to use, fast, reliable and offline. Today we already have a prototype that integrates all the necessary elements to detect nutritional status through an image in a semi-automatic way. We are working on a new prototype that will complete the process, this time in a 100% automatic way, thus ensuring its use by any user profile.

d. Research continues. We have completed the first stage of research related to the identification of moderate acute malnutrition (MAM) as well as risk of malnutrition (RAM), which is currently in the publication phase. These four groups, SAM, MAM, RAM and ONC (optimal nutritional condition) coincide with the classification of nutritional status defined by the World Health Organisation in relation to acute malnutrition. The results obtained will allow us to further optimise our tool and facilitate not only the early identification of acute malnutrition in its different stages, but also the fundamental and necessary task of preventing the disease.

We are currently investigating the potential of the methodology we have designed in the identification of chronic malnutrition in Guatemala.

e. Our academic partners. During this process, several research groups from the Cheikh Anta Diop University of Dakar: LARNAH (nutrition and food), LASAP (sociology, anthropology and psychology), LARTES (economics and sociology) and the Complutense University of Madrid: EPINUT (nutrition), HumLog (humanitarian logistics) have been our allies and guarantors of applied scientific rigour and the Carlos III University of Madrid (Department of Statistics).

2. DESIGNING THE SCALING PLAN

Once the scientific foundation of **SAM Photo App** was created, we started designing the strategy to introduce the tool in operational working contexts. Our scaling strategy rests on three main pillars:

1. **The diversity of geographical contexts,** as our methodology depends on human phenotypes, and these vary with geography. We are now working in five countries and three continents.

2. **The diversity of operational contexts.** Our users range from parents and other community actors at the community level to health workers in health facilities, so it is critical for us to understand the particularities of each operational context to determine how best to integrate **SAM Photo App.**

3. **Promote the appropriation of the application by local users.** Our aim is that each SAM Photo App partner takes ownership of the use of the tool and leads its deployment and use locally. To this end, we dedicate time and effort to train staff in each context in the use of **SAM Photo App.**

3. OWNERSHIP AND POSITIONING

SAM Photo App's value proposition seeks its integration in all areas where its use can make a difference. Therefore, the positioning of **SAM Photo App** involves:

- To **provide stakeholders with an innovative, rapid and reliable child nutrition screening tool** that can save the lives of severely malnourished children.
- To be able to **equip community workers with this tool and encourage regular nutritional screening** for early detection of cases of severe and moderate acute malnutrition, mainly in the most remote areas. Our ultimate vision is that the application can be used at home by mothers, fathers and/or caregivers.
- **Sensitise communities** on the importance of regular nutritional screening and engage them in regular nutritional screening.
- **Strengthening health systems** by facilitating the digitisation, aggregation and analysis of nutritional data in real time. Our vision includes being able to support health authorities in making better decisions based on available and reliable data.
- **Connect SAM Photo App with other nutritional data management and processing platforms** such as the SMART undernutrition monitoring and assessment methodology or the DHIS2 global health information management system, among others, in order to contribute to a better understanding of this global public health problem.

GEOGRAPHICAL SCOPE

Africa

• **Senegal.** It is the first place where we have developed and tested the **SAM Photo App** technology in real cases. It is the country where we have generated the scientific evidence that supports the methodology we use. In Senegal, we work in the Matam region, bordering Mauritania, located in the Senegalese Sahel.

• **Uganda.** It is the second African country to join the portfolio and the first in East Africa. Here **SAM Photo App** will be tested for the first time in the context of a displacement camp. Our foray into this field is in coordination with UNHCR.

• **Mauritania.** It is the most recent country to join the partnership and the second in the Sahel region. The project is expected to be developed towards the south-east of the country, an area at high risk of food insecurity and malnutrition.

Latin America

• **Guatemala.** In this context, in addition to continuing to explore the influence of phenotypic differences on the accuracy of our diagnostic method for acute malnutrition, we have further explored the study of chronic malnutrition.

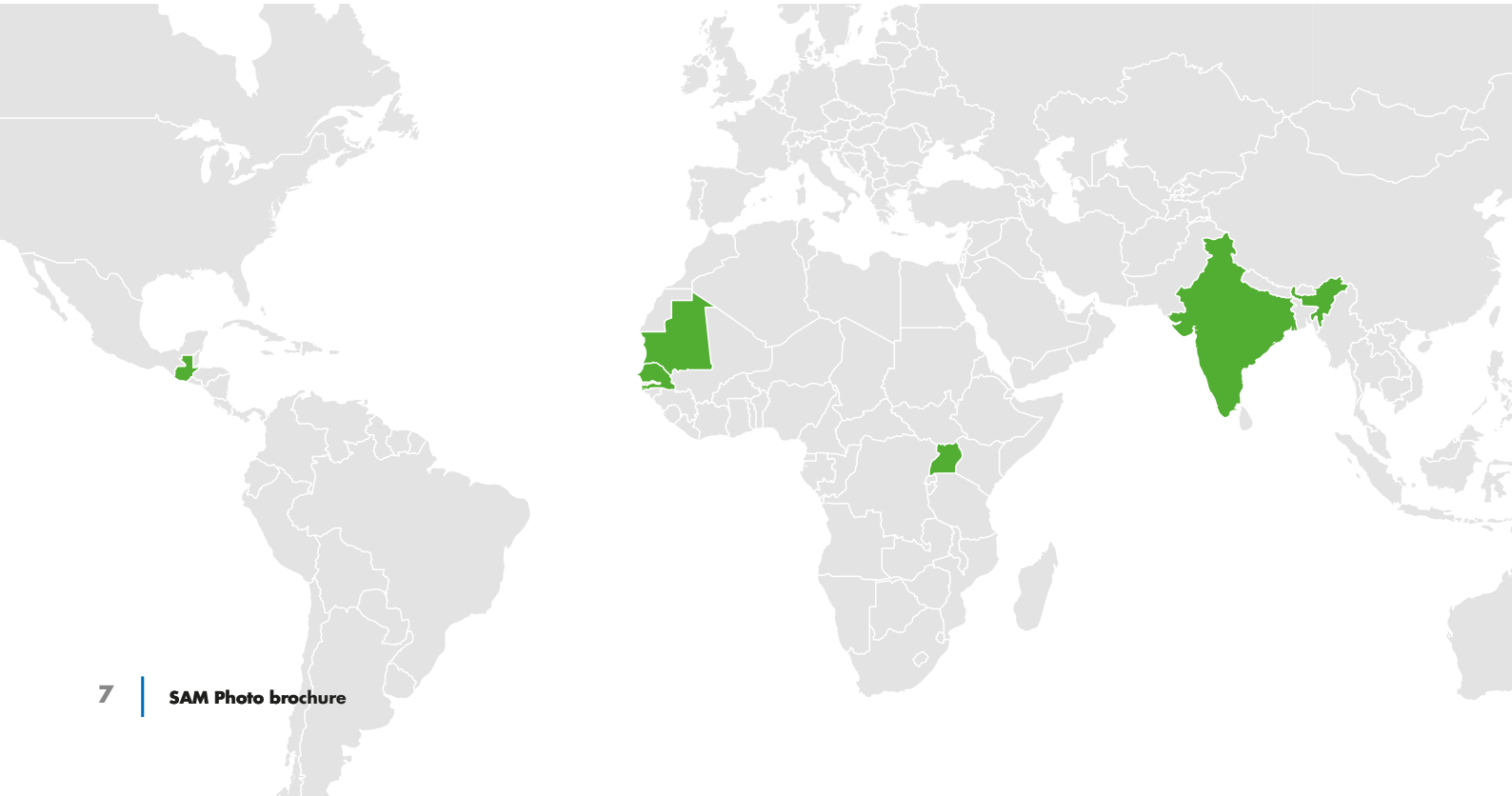
Southeast Asia

• **India.** It is the first Asian country to join **SAM Photo App**'s global portfolio. In addition to being one of the most populous countries in the world, the rate of malnutrition is proportional to the size of the population. The introduction of **SAM Photo App** in this context on an operational basis will be of great benefit to the National Response to Child Malnutrition.

IN THE **SCALING PLAN** OF THE **SAM PHOTO** APP PROGRAMME WE HAVE AS NEXT DESTINATION POINTS:

• **Sahel.** Expansion of our operations in the Sahel region in two lines of work. Continue to support deployment in the Western Sahel including Mali and Niger as new contexts in this area. Initiate deployment in the Eastern Sahel with South Sudan as a priority country.

• **Southeast Asia.** Expansion of our operations in Southeast Asia, specifically to countries where child malnutrition presents a significant epidemiological burden. In this region, we have Nepal and Bangladesh on the agenda.



NEXT STEPS

Operational and scaling plane

We now operate in five countries across three continents. Our operational objectives include: i) To continue to advance the incorporation of **SAM Photo App** into the nutritional screening activity carried out by local partners in the countries where we are currently working; ii) To scale up our operational activity to new contexts, where malnutrition represents a major public health problem.

Scientific level

We continue to build and strengthen the scientific foundation of the **SAM Photo App.** The main scientific objectives are: i) To complete the ongoing studies to produce the necessary evidence to train the algorithm also in the detection of moderate and chronic child undernutrition; ii) To complete the necessary studies to produce the necessary operational evidence to facilitate the integration of the **SAM Photo App** into regular screening activities (feasibility, acceptability and cost-effectiveness).

Technology development plan

We continue to refine the functionality of the app. Our main technology development objectives are: i) To integrate the recommendations from the functional tests; ii) To design an appropriate strategy to connect **SAM Photo App** to other platforms for collecting, storing and analysing nutritional data such as SMART+, DHIS2 and Phosan Tracker.

SCIENTIFIC CONTRIBUTION

The dissemination of the research developed during the **SAM Photo App** design process includes the **presence of our scientific team in the main international meetings for the exchange of knowledge on nutrition and diagnosis:** International Conference on Nutrition and Growth, Nutrition Conference of the American Nutrition Association, Congress of the Latin American Nutrition Society, Conference of Federation of African Nutrition Societies, among others.

SIMILARLY, THE **FOLLOWING SCIENTIFIC PUBLICATIONS** HAVE BEEN PRODUCED TO DATE:

- Measuring the Impact of Stunting on Child Growth Considering Ontogeny and Sexual Dimorphism
  Laura Medialdea Marcos & Jessica Alejandra Coronado Aguilar. Maternal and Child Nutrition. 21/07/2023

- Approaching Nutritional Status by Means of Geometric Morphometric Methods
  Laura Medialdea Marcos & Antonio Vargas Brizuela. Human Growth and Nutrition in Latin American and Caribbean Countries 01/06/2019

- Revolutionizing malnutrition screening through innovation: SAM Photo Diagnosis App Program
  Medialdea, L., Burgos-Soto, J. S., & Gómez, A. International Conference of Nutrition & Growth. 16/02/2024

- Severe acute malnutrition morphological patterns in children under five
  Medialdea, L., Bogin, B., Thiam, M. et al. Nature. 19/02/2021

- Describing the children's body shape by means of Geometric Morphometric techniques
  Laura Medialdea, Cayetana Bazaco, Manuel Domingo D'Angelo del Campo, Carlos Sierra-Martínez, Rolando González-José, Antonio Vargas, María Dolores Marrodán. American Journal of Biological Anthropology. 10/01/2019

- Development of a SAM photo diagnosis app (EN); Development of a SAM photo diagnosis app (FR)
  Laura Medialdea Marcos, Iván Molina Allende and Antonio Vargas Brizuela. Emergency Nutrition Network. 06/10/2018

AWARDS AND RECOGNITIONS

- **2024** UN Global Compact and Rafael del Pino Foundation.
  Premio Go!ODS – Mejor Iniciativa para el ODS#3. Salud y Bienestar
- **2023** Webby Awards.
  Premio Gold Anthem a la Mejor Acción Humanitaria
- **2023** Fast Company. Finalist for the
  Ideas that Change the World Award
- **2020** Mutua Madrileña.
- **2019** ESIC University. **ASTER Digital Innovation Award**
- **2019** DKV.
- **2018** Vodafone American Foundation. Finalist.
  Wireless Innovation Project
- **2017** Aid & International Developement Forum.
  Inclusion in the guide "Solutions that save lives and support development"
- **2016** Medical Journal. Best Ideas Award 2016.

LEARN MORE

Discover how SAM Photo App is revolutionizing nutritional diagnosis

SAM
SEVERE ACUTE MALNUTRITION
PHOTO
DIAGNOSIS APP

Our vision is a world where the app is available to everyone - from parents to health workers in remote communities, which supports local health systems. Thanks to the SAM Photo App, they will be able to detect signs of acute malnutrition early and refer children for appropriate treatment, making the difference between life and death.

ACTION AGAINST HUNGER

To learn more about SAM Photo:
samphoto@accioncontraelhambre.org

You can download a digital version of this brochure **here**