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Needs, Acceptability, and Value of Humanitarian Medical Assistance in Remote Peruvian Amazon Riverine Communities

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Abstract. Much debate exists regarding the need, acceptability, and value of humanitarian medical assistance. We conducted a cross-sectional study on 457 children under 5 years from four remote riverine communities in the Peruvian Amazon and collected anthropometric measures, blood samples (1–4 years), and stool samples. Focus groups and key informant interviews assessed perspectives regarding medical aid delivered by foreigners. The prevalence of stunting, anemia, and intestinal parasites was 20%, 37%, and 62%, respectively. Infection with multiple parasites, usually geohelminths, was detected in 41% of children. The prevalence of intestinal parasites both individual and polyparasitism increased with age. Participants from smaller communities less exposed to foreigners expressed lack of trust and fear of them. However, participants from all communities were positive about foreigners visiting to provide health support. Prevalent health needs such as parasitic infections and anemia may be addressed by short-term medical interventions. There is a perceived openness to and acceptability of medical assistance delivered by foreign personnel.

INTRODUCTION

Resource-limited areas often have limited financial capital, human resources, and infrastructure in a wide array of areas such as education, security, transport, and health.[1–3] The Department of Loreto is located in the Peruvian Amazon basin, the region with the worst health indicators[4] and the highest risk of infectious diseases[5] in Peru. This region also has the highest incidence of malaria, diarrheal disease, and dengue in the country, similar to other tropical rural areas in Latin America and the Caribbean.[6]

The people of the Amazon region often live in small villages along the Amazon River and its tributaries,[5] some of them in very remote river basins. Most of this population consider themselves as "mestizo," descendants from indigenous populations who use and accept occidental culture.[7] Poor health status across all of these populations, in addition to inadequate health infrastructure and resources, limit their access to quality health services.[5] Young children in the region, particularly those less than 5 years of age, frequently experience nutritional deficiencies, with increased risk of resulting developmental disorders at critical stages of growth.[8] The remote location of many of these populations and large distances between communities creates further challenges.[7] Therefore, the Peruvian Ministry of Health (MoH) and other governmental agencies face significant difficulties when trying to provide necessary health services.

To provide medical care and improve the well-being of Amazonian and other vulnerable populations worldwide, nongovernmental organizations (NGOs), religious organizations, and foreign institutions carry out humanitarian assistance (HA). HA programs aim to address health disparities through provision of short-term basic health-care services and occasionally by supporting infrastructure development to meet basic human needs such as water and sewage.[9] Health-wise, HA programs focus mainly on acute conditions that can be addressed with a single intervention, such as treatment of intestinal parasites, fungal skin diseases, and nutritional deficiencies.[10] These programs are generally carried out by trained health personnel from different specialties (pediatrics, nutrition, dentistry, dermatology) and often focus on the most vulnerable populations such as children and pregnant women.[11] The Department of Defense of the United States of America (US-DoD), often conducts HA activities in developing countries as part of "Medical Readiness Training Exercise" (MEDRETEs). The main goal of MEDRETEs is to train active duty personnel of the U.S. Armed Forces in the delivery of medical care in remote areas with limited access to health care. Secondary benefits of MEDRETEs include provision of humanitarian and civic assistance, health-care services, and treatment.[12,13]

HA activities are often criticized for poor integration with local health services and limited evidence of a lasting positive impact, mainly because of their short duration and lack of intensity and continuity.[9,14] In an attempt to address these criticisms, the U.S. Air Force selected four remote riverine communities in the Amazon rainforest for repeated MEDRETE interventions in consecutive years starting in 2009. The expectation was that through repeated interventions in those communities, HA could potentially continue to improve the health of community members, especially children. Attempts were also made to improve the sustainability of the impact of interventions by providing training to local MoH personnel stationed in the area,[15,16] while accomplishing the primary training goal of MEDRETEs.

The possibility of offering repeated health interventions in these communities provided a unique opportunity to assess the impact of the MEDRETE HA activities. We performed a baseline evaluation of the health status of children under 5 years in these four communities before the beginning of HAs because children in this age range are one of the main target populations for their activities. The main goals of this study were 1) to identify health needs in vulnerable population amenable to be addressed by HA and suggest potential interventions, 2) assess the acceptability of HA, and 3) to provide

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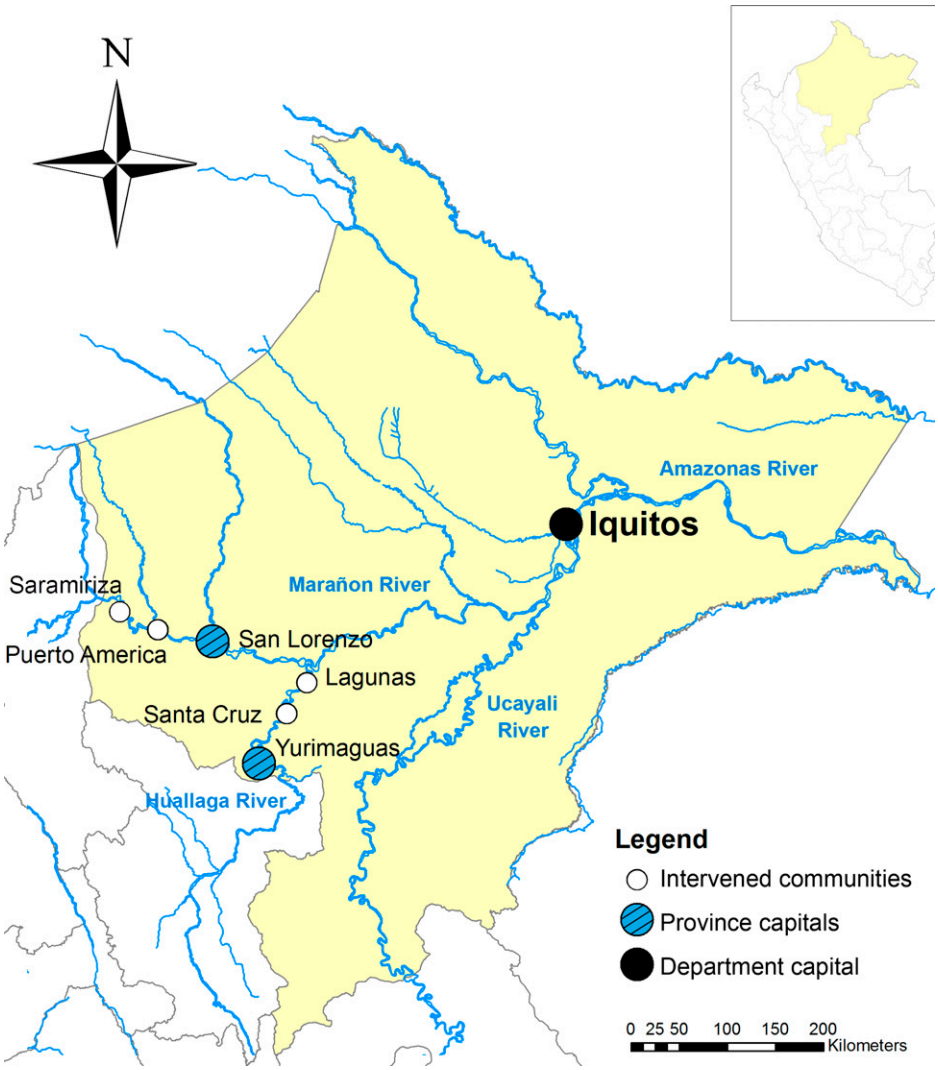

FIGURE 1. Location of study communities in Loreto, Peru.

baseline information about health status of children that could be used to evaluate the impact of the HA actions.

MATERIALS AND METHODS

Settings. Between January and March 2009, we conducted a cross-sectional health assessment prior to a planned HA intervention. We included four remote riverine communities in the western region of the Department of Loreto, located in the Peruvian Amazon Basin: Saramiriza (population: 1,947) and Puerto America (population: 601), along the Marañón River; and Lagunas (population: 6,317) and Santa Cruz (population: 1,910), along the Huallaga River (Figure 1). Public services in these communities are very limited (Table 1). The weather in this area is rainy and tropical with an average relative humidity of 84% and a mean temperature of 27°C (22–36°C). Rainfall increases between December and March.[5] Travel time to the nearest large city (Yurimaguas, population: 45,756), is 2–12 hours by speed boat, and much longer via the slower boats commonly used for local transport. All four communities mainly have non-potable drinking water sources, poor sanitation facilities, and practice open defecation, according to the categories reported in the Joint Monitoring Programme for Water Supply and Sanitation (JMP) method by the World Health Organization (WHO).[17] Also, they have 3–8 hours of electricity daily, depending on the community. River water is used by the population for cooking, drinking, and other daily activities, and the people from these communities eliminate litter and feces in the river or in the open field. A few members of the communities have access to latrines, but the latrine waste goes directly to the river.

Local health services are similarly limited. Most healthcare providers are recent graduates from different health

TABLE 1
Socioeconomic characteristics of the communities studied

	Saramiriza	Puerto America	Lagunas	Santa Cruz
Population	1,324	640	5,418	769
Time to Yurimaguas (hours, regular boat)	48	40	16	10
Electricity (hours/day)	3	4	8	4
Improved water sources	Partial	None	Partial	None
Improved sanitation facilities	Partial	None	Partial	None

professions (e.g., physicians, nurses, veterinarians) performing a year of rural service as part of the national Rural and Marginal Urban Areas Health Service (SERUMS) program. Saramiriza and Lagunas have the best-staffed health facilities; however, only two physicians and two nurses provided services at each facility during the time of the study. The health facility in Puerto America is the smallest (80 m^2) and had no physicians, but only one professional midwife, one nurse, and two technicians on staff. Santa Cruz has a health facility with better infrastructure than Puerto America but both only had a physician and nurse. Also, no health facility possessed laboratory equipment or a well-stocked pharmacy. The nearest hospital with capacity to address more complex medical problems is located in Yurimaguas (Table 1).

Fieldwork. We performed a population census to identify eligible individuals in the four communities. Then, we randomly selected prospective participants for a baseline assessment in three study groups: children under 5 years, 15–49 years "adult" caretakers of children under 5 years, and 15–49 years "adult" female and male sampled independently. The "adult" age range (15–49 years) was selected for comparability with the Demographic Health Surveys (DHS) standard age group used worldwide. The sample size of each study group was proportional to the number of inhabitants in that group for each community. Four 2-person teams conducted field operations for 52 days. Fieldworkers were health personnel and two of the authors (J.F.S. and A.M.B.) trained them over 3 days in all study procedures (surveys and sample collection). A pilot study was conducted to confirm that all the procedures were understood. JFS was with the team throughout field activities and had daily meetings to address questions or doubts. The local population speaks Spanish and interpreters were not needed. In this manuscript, we only present results from children under 5 years, the most vulnerable of the three populations.

The data collected with qualitative (focus groups and key-personnel interviews) and quantitative (questionnaires and biological samples) components were used to evaluate the potential value of HA activities according to the community members and local MoH personnel.

Surveys. Trained personnel conducted interviews during household visits using questionnaires previously applied in Peru and piloted in the field by JFS. Two questionnaires were used: a census form and a survey regarding children's health. The census form was based on the 2007 Peruvian census questionnaire. Key data were recorded, including geographic coordinates, basic household characteristics, and sociodemographic information, from each household member adjusting content for readability. The children questionnaire followed closely the standard DHS survey applied in Peru since 1986. The child survey was filled by a fieldworker with the information provided by the caretaker. The survey asked caretakers about one of their children under 5 years who lived in the house. Caretakers were asked about their threshold for seeking health care for their child and their child's perceived health status, immunizations received, and recent illnesses. In addition, fieldworkers requested the child's immunization card to collect vaccination records. If unavailable, the caretaker asked about the immunizations received by the child. Efforts were made to apply the questionnaires in a private setting with an interviewer of the same sex as the caretaker. Also, the survey measured some benefits in members of the communities and local MoH personnel such as perception about MoH personnel and use of health-care facilities. We did not evaluate the benefits in U.S. Air Force personnel in training during this MEDRETE.

Anthropometrics. Height and weight were measured in all participants. Standard scales following United Nations Children's Fund (UNICEF) standards were used to measure weight (Seca 840, Hamburg, Germany). Stadiometers were locally made following specifications from UNICEF and the Peruvian National Center for Feeding and Nutrition and validated prior to the study. Weight and height were measured with a precision of ±100 g and ±0.1 cm, respectively. Participants were asked to wear the minimal clothing needed and no shoes to avoid overestimations, and the weight of the clothes worn was discounted using standard cloth weight tables. The recumbent length of children under 2 years was measured lying on their backs and the height of children 2 years and older was measured standing up. Two members of the field team worked together to carry out the anthropometric measures. Stunting and wasting were defined as height-for-age and weight-for-height less than –2 z-scores below the median of the WHO child growth standards, respectively.

Assessment of malaria and anemia. Peripheral blood obtained by finger prick was used to diagnose malaria and assess anemia by puncturing the third finger of the left hand of all participants age 1 year and over. Standard methods and universal precautions were used. Three or four drops were collected per child: two were used for malaria diagnosis by thick and thin blood smears stained on-site with Giemsa stain and one or two for anemia testing. Smears were examined for malaria in batch at the local health facilities and confirmed by a second reading at the U.S. Naval Medical Research Unit No. 6 (NAMRU-6) in Iquitos.[18] The result of the first reading was reported to parents within 24 hours of sample collection following MoH reporting practices. One or two drops were placed in a microcuvette for on-site hemoglobin testing using a Hemocue® electronic measurement device (HemoCue HB 201 + Analyzer, HemoCue AB, Angelholm, Sweden). Upon obtaining the result, the fieldworker reported to the caretaker whether the child had anemia according to international standards (hemoglobin < 11 g/dL in children). Results were also recorded on the questionnaire.

Enteric parasites. We collected one stool sample from each participant. Twenty grams of stool were placed into sodium acetate–acetic acid–formalin solution to preserve intestinal parasites. Specimens were also placed in cryovials and kept in a nitrogen tank to preserve fresh stool. The samples were processed with the Ritchie concentration technique[19] using ethyl acetate instead of ether. Stool smears were read by experienced microscopists under direct observation using saline and Lugol's iodine solution at NAMRU-6 in Lima and Iquitos to identify intestinal parasites. Unconcentrated stool was spotted onto slides for modified Kinyoun's stain to look for *Cryptosporidium* spp. and *Cyclospora cayetanensis*.

The cryovials were sent to the U.S. Centers for Disease Control and Prevention (CDC) and Division of Parasitic Diseases and Malaria in Atlanta, GA, for molecular testing for *Entamoeba histolytica*/*Entamoeba dispar*, *Giardia lamblia*, and *Cryptosporidium* spp. Four hundred micro liters of fecal suspension were processed as instructed with the FastDNA SPIN kit for Soil (MP Biomedicals, Irvine, CA). For conventional polymerase chain reaction (PCR), we used a region

of 877 base pairs (bps) of the small subunit ribosomal RNA (SSU rRNA) and for real-time PCR (RT-PCR), we used TaqMan RT-PCR based on the SSU rRNA gene. Primers Ehd-239F and Ehd-88R amplified a 172-bp fragment of the SSU rRNA gene of *E. histolytica*/*E. dispar*. The amoebae were discriminated with species-specific probes *E. histolytica*-96T and *E.dispar*-96T, respectively. For *G. lamblia*, specimens were confirmed by TaqMan RT-PCR targeting a 105-bp fragment of the SSU rRNA gene. The molecular characterization of *G. lamblia* was done using nested PCR to amplify a ~532-bp fragment of the triose phosphate isomerase (TPI) gene. The genotyping of *Cryptosporidium* spp. used a SSU rRNA-based PCR-restriction fragment length polymorphism that differentiated *Cryptosporidium* spp. Identification of selected genotypes was confirmed by DNA sequence analysis of these amplicons. The subtypes of *Cryptosporidium hominis* were determined by sequence analysis of a ~850 bp fragment of the 60-kDa glycoprotein gene.[20]

Qualitative assessment. The objective of the qualitative component was to explore local perspectives regarding health and well-being and factors that influence health and humanitarian aid from potential direct and indirect beneficiaries. Seventy individuals were recruited using purposive sampling. Four focus groups were conducted, one in each community, with a total of 34 participants overall and 8–10 participants per focus group. In addition, 36 in-depth, semi-structured interviews of indirect beneficiaries were conducted with formal and informal community leaders such as health-care personnel, mayors, heads of women's organizations, heads of community kitchens (*comedores populares*), and the Glass of Milk program. We selected community leaders for interviews because they have important opinions regarding issues of interest to the community since that is part of their role as leaders. Also, they tend to be outspoken and their opinion is respected and rarely challenged by community members; for this reason, is not productive to include them on focus groups. Focus group participants and interviewees were recruited by the qualitative research assistant in cooperation with local collaborators in each community. Both focus groups and interviews addressed diverse topics. First, they engaged participants about how they define and perceive health and well-being and the factors that contribute to each and about the current state of health and well-being among residents of their community. Then, they asked participants about common health problems among children. Next, they asked participants about factors and resources that both improve and weaken their health and well-being. Finally, the focus groups and interviews asked participants about their perceptions regarding the presence of foreigners and HA in their communities. The focus groups and interviews were carried out by the qualitative research assistant, a Peruvian sociologist with extensive training in qualitative research and ethics and extensive experience implementing qualitative data collection with diverse populations in Peru. The research assistant and AMB, a qualitative researcher, analyzed the data using a grounded theory approach. Following thorough reading of the focus groups and interviews, they developed an initial codebook. Then, they separately coded one focus group and two interview transcripts and then jointly reviewed the coding to standardize the coding process and refine the codebook. Next, the research assistant coded the remaining transcripts. Finally, the research assistant and AMB worked together to summarize the results, comparing similarities and differences across the four communities.

The audio of the narrative portion of the focus groups and all the in-depth interviews was recorded with the consent of the participants. The recordings and notes were transcribed and the resulting transcripts were analyzed using a grounded-theory approach. Once each set of interviews was complete, coding was carried out using the Atlas-ti software program (Scientific Software Development GmbH, Berlin, Germany, 2005). The participatory portion of the focus groups was recorded jointly with the participants, in addition to notes that were taken during and after the focus group by the facilitator. All recorded materials were then analyzed by an experienced PhD level internationally trained scientist (AMB) who resides in Peru for 8 years, drawing parallels and differences across the study communities.

Statistics. Dichotomous outcomes such as disease prevalence are presented as proportions and numerical outcomes are presented as means or medians depending on the presence of outliers. We calculated 95% confidence intervals with exact binomial methods for the main dichotomous outcomes. Comparison of proportions across years used χ^2 and Fisher's exact tests if needed, whereas we used Student's t and Mann–Whitney–Wilcoxon tests for numerical outcomes depending on the presence of influential outliers. All analysis were conducted with Stata 13.0 (Stata Corp., College Station, TX) using a 0.05 significance level.

Ethics. The Institutional Review Board (IRB) of NAMRU-6 approved the study protocol in compliance with all applicable U.S. federal regulations governing the protection of human subjects. In addition, the Loreto Regional Health Directorate (DIRESA) in Iquitos and the Alto Amazonas Health Network in Yurimaguas approved the study on behalf of the Peruvian MoH. Work at CDC was approved by the CDC-IRB. In addition, community consent was obtained from community leaders identified by local MoH personnel, as a collaborative effort between study personnel and local MoH personnel. Each participant in the quantitative and qualitative components as well as the parents of all children engaged in a standardized informed consent process and provided signed informed consent prior to initiating participation. All approvals were obtained before starting any activities in each community.

RESULTS

Six communities were preselected in coordination with the local Peruvian MoH according to criteria such as lack of basic services (sanitation, safe water, and electricity), access by large ships from the Peruvian Navy, and presence of health services. The team visited all the communities and four were chosen. We evaluated 1,752 households (65% of the total) in the four communities during the census and enrolled 457 children under 5 years (39% of the total) and their caretakers.

Sociodemographic characteristics. The study sample was approximately distributed proportional to the size of each community, and 58% of the children were from Lagunas. The number of males and females was similar (49% versus 51%). Participants' mean age (± standard deviation) was 29 ± 18.5 months and there was no difference in average age between communities (P = 0.096). The demographic characteristics of the children that participated are presented in Table 2.

TABLE 2
Demographic characteristics of the children studied

	Total	Saramiriza	Puerto America	Lagunas	Santa Cruz	
	(*N* = 457)	(*N* = 85)	(*N* = 25)	(*N* = 266)	(*N* = 81)	*P* value
Sample*	39%	47%	20%	35%	68%	–
Sex						0.555
Male	49% (224)	45% (38)	40% (10)	50% (133)	53% (43)	–
Female	51% (233)	55% (47)	60% (15)	50% (133)	47% (38)	–
Age in months†	28.5 ± 18.5	29.6 ± 18.2	34.4 ± 18.8	26.7 ± 18.3	30.9 ± 18.7	0.096
Age groups						0.237
< 1 year	28% (126)	21% (18)	20% (5)	32% (85)	22% (18)	–
1–2 years	32% (147)	31% (26)	32% (8)	32% (86)	33% (27)	–
3–4 years	40% (184)	48% (41)	48% (12)	36% (95)	45% (36)	–

*This percentage represents the number of children enrolled in total and per community according to the census.
†Mean ± standard deviation.

Nutritional status. As shown in Table 3, the prevalence of stunting in all children was 20% (81/406). Puerto America (33%) had the highest prevalence, but there were no statistical differences between the communities ($P = 0.466$). The highest prevalence of stunting occurred in children over 1 year ($P < 0.001$). The overall prevalence of wasting was 3% (13/406), very similar among the communities ($P = 0.929$) but lower in children who were 3–4 years in comparison with children 1–2 years (2% versus 8%, $P = 0.022$).

The mean hemoglobin level in children aged 1–4 years was 11.2 ± 1.1 mg/dL (range: 7.3–14.6) and the prevalence of anemia was 37%. Hemoglobin levels were different across communities ($P = 0.003$), with the highest mean in Saramiriza (11.5 mg/dL) and the lowest in Lagunas (11.1 mg/dL); however, this did not result in significant differences ($\Delta \leq 17\%$) in anemia across the four towns ($P = 0.117$). We also found lower hemoglobin levels in children 1–2 years compared with children 3–4 years (10.8 versus 11.6 mg/dL, $P < 0.001$) and corresponding higher levels of anemia in 1–2 years versus 3–4 years (55% versus 23%, $P < 0.001$).

Intestinal parasites and malaria. The prevalence of intestinal parasites was 62% (Table 4). The most common were *Ascaris lumbricoides* (29%), *G. lamblia* (20%), *Trichuris trichiura* (16%), hookworms (5%), and *Strongyloides stercoralis* (2%). The four communities presented statistically different prevalences of the four parasites, potentially due to differences in infrastructure (urbanization) and access to antiparasitic drugs between communities: *G. lamblia* ($P = 0.011$), *T. trichiura* ($P < 0.001$), *E. histolytica*/*E. dispar* ($P = 0.001$), and *S. stercoralis* ($P = 0.013$). The prevalence of most intestinal parasites increased with age. Polyparasitism was similarly frequent across the four communities ($P = 0.179$), but its prevalence also increased with age ($P < 0.001$).

Thirty-four samples positive by microscopy for *E. histolytica*/*E. dispar* (8%) were evaluated by conventional PCR and RT-PCR. Eleven samples (32%) positive for *E. dispar* by conventional PCR and 18 (53%) were positive by RT-PCR. No sample was positive for *E. histolytica* by conventional PCR or RT-PCR. Seventy-two of 80 samples (90%) positive by microscopy for *G. lamblia* were confirmed positive by RT-PCR. Forty-three of these specimens were successfully amplified by TPI PCR and sequenced. Three children (7%) had assemblage A, and 40 (93%) had assemblage B. BS1 was the most frequent sub-assemblage, found in 35% of the samples (15/43). Six participants were simultaneously infected with two B sub-assemblages.

Coccidian protozoans were also found by modified acid-fast staining. Twenty samples (4%) were identified as *Cryptosporidium* spp.; also three were reported as *C. cayetanensis*. Seven samples identified as *Cryptosporidium* spp. were successfully characterized at the species level. The species detected were *Cryptosporidium hominis* ($N = 5$) and *Cryptosporidium canis* ($N = 2$). Subtyping was successful in four of five participants with *C. hominis:* subtypes IaA13R7 ($N = 1$), IbA10G2 ($N = 2$), and IeA11G3T3 ($N = 1$). None of the *C. cayetanensis* were confirmed by molecular methods.

Direct microscopic evaluation of 327 blood smears revealed no evidence of *Plasmodium* or filariasis infection in any participant. Quality control was performed for expert microscopists in NAMRU-6, Iquitos and a concordance of 100% was found with the results from local MoH microscopists.

Immunizations and reported health status. We assessed immunizations in children over 1 year old using the information collected from the vaccine cards (41%) or from caretakers (59%), if vaccine cards were not available. We found that only 71% of children over 1 year completed the full Peruvian immunization schedule, which at that time included hepatitis B, polio, measles, mumps, *Haemophilus influenzae* type b, and yellow fever,[21] among other vaccines (Table 5).

In addition, we evaluated children's health status asking caretakers if children had fever, cough, or diarrhea in the 2 weeks before the survey and what they did to face this situation. They reported that 49% of their children had a cough, 34% had a fever, and 29% had diarrhea. When the children had fever, cough, or diarrhea, 72%, 60%, and 35% of the caretakers, respectively, sought care at a MoH health facility. Over half (57%) of caretakers whose children had a fever sought care during the first day with fever, in comparison to 37% of those with cough ($P < 0.001$) and 26% of those with diarrhea ($P < 0.001$). According to the caretakers, about half of the children with fever (55%) or cough (45%) were seen by a physician compared with a quarter of diarrhea cases (25%). Nearly all children with fever in the last 2 weeks received antipyretics (89%) and only 10 children with fever (6%) received other drugs such as antibiotics (amoxicillin) or corticosteroids. Half of the children (49%) received treatment of intestinal parasites in the last 12 months.

Finally, caretakers reported 61% of their children had good physical well-being and 67% had good emotional well-being. Fieldworkers also noted participants with decayed teeth and low visual acuity, another issue that can be addressed by short-term medical missions, although this was not systematically assessed in all participants.

Table 3
Nutritional status of children by community and age groups

	Total	Community					Age group			
		Saramiriza % (n/N)	Puerto America % (n/N)	Lagunas % (n/N)	Santa Cruz % (n/N)	P value	< 1 year % (n/N)	1–2 years % (n/N)	3–4 years % (n/N)	P value
Anthropometric measures										
Stunting	20% (81/406)	18% (14/77)	33% (7/21)	19% (45/232)	20% (15/76)	0.466	5% (6/110)	25% (33/133)	26% (42/163)	< 0.001
Wasting	3% (13/406)	3% (7/77)	0% (0/21)	3% (8/232)	4% (3/76)	0.929	0% (0/110)	8% (10/133)	2% (3/163)	0.022
Hemoglobin (Hb), g/dL*	11.2 ± 1.1	11.5 ± 1.1	11.2 ± 0.9	11.1 ± 1.1	11.3 ± 1.1	0.028	–	10.8 ± 1.2	11.6 ± 0.9	< 0.001
Anemia % (Hb < 11 g/dL)	37% (118/321)	25% (17/67)	32% (6/19)	42% (72/172)	37% (23/63)	0.117	–	55% (77/140)	23% (42/181)	< 0.001

*Mean ± standard deviation.

Qualitative evaluations. Participants in focus groups and interviews defined health as the absence of illness and underscored that good health is important to be able to work. Well-being was described as a broad, comprehensive concept. Participants in most communities reported average health and well-being across adult and child populations, which leaders attributed to improvements in and expanded use of health-care services. However, in the very small community of Puerto America, residents considered their health to be weak due to the lack of appropriate medical care and medications, as well as the numerous diseases faced by the population:

> *The situation of the community and well-being is chaotic. [The population] doesn't enjoy quality of life, also due to factors such as habits and lifestyles... The general population doesn't have good habits, above all given what you see in terms of incidences of several illnesses, like ARIs, ADDs and parasitosis. (Head of Health center, Male, Interview, Puerto América)*

The child health ailments that participants considered to be most important were bronchial disease, diarrhea, and parasitic infection. Other problems perceived as common were upper respiratory infections in Saramiriza and Puerto America; malaria and other causes of fever in Saramiriza; anemia in Lagunas; and pneumonia and vomiting in Santa Cruz. Personal hygiene was mentioned as the factor that had the greatest positive influence on health in all of the communities, and the following factors were mentioned in three out of four communities: hand washing, washing and cooking food well, drinking boiled water, evaluation at MoH health facilities, and maintaining the cleanliness of the latrine. Lack of improved sanitation facilities was mentioned as the main factor that weakens or worsens health, in addition to lack of improved drinking water sources, lack of bathrooms or latrines, and littering. Participants also mentioned contamination by oil extraction companies and contamination of the river due to its use as a trash dumping area. All participants stated that most community members are informed about disease prevention practices, but that they still do not use them.

All four communities mentioned that they have three important resources in their communities: the MoH facility, preschools, and schools in general. They spoke at length about pharmacies and traditional healers, both of which exist in greater number than skilled health-care providers, although they also recognized that their local pharmacy personnel may not be trained health-care providers. A health-care professional interviewee mentioned that traditional healers tend to wait too long before referring their clients to formal health facilities.

In the larger community of Lagunas, participants reported more contact with foreigners, as the community is one of the entry points to an internationally recognized national reserve (Pacaya Samiria), and because they received health campaigns and visits by religious groups in the past. Participants were satisfied with these visits, especially since they felt they do not receive sufficient support from the MoH health system. The other communities, however, reported a minimal presence of foreigners. They said that non-Peruvians usually came to carry out research, but the local inhabitants had not seen the results of the studies. All participants, and particularly women, expressed discomfort, lack of trust, and even fear regarding foreigners. Many mentioned that they were

TABLE 4
Prevalence of intestinal parasites of children by community and age groups using microscopy

	Total (*N* = 453)	Community					Age group			
		Saramiriza (*N* = 82)	Puerto America (*N* = 25)	Lagunas (*N* = 265)	Santa Cruz (*N* = 81)	*P* value	< 1 year (*N* = 126)	1–2 years (*N* = 145)	3–4 years (*N* = 182)	*P* value
Two or more parasites	41%	38%	60%	39%	44%	0.179	6%	32%	71%	< **0.001**
One or more parasites	62%	60%	76%	60%	64%	0.439	25%	63%	86%	< **0.001**
Ascaris lumbricoides	29%	24%	48%	29%	27%	0.147	6%	28%	46%	< **0.001**
Giardia lamblia	20%	30%	32%	16%	17%	**0.011**	2%	19%	33%	< **0.001**
Trichuris trichiura	16%	22%	52%	10%	19%	< **0.001**	0%	10%	31%	< **0.001**
Entamoeba dispar	8%	9%	0%	5%	19%	**0.001**	3%	8%	11%	**0.034**
Hookworms	5%	6%	8%	4%	5%	0.683	1%	2%	9%	< **0.001**
Strongyloides stercoralis	2%	2%	12%	1%	4%	**0.013**	0%	3%	3%	0.081
Cryptosporidium spp.	4%	6%	0%	4%	5%	0.697	2%	8%	4%	0.053
Cyclospora cayetanensis	1%	1%	0%	1%	0%	0.801	1%	1%	1%	1.000

Bold indicates $P < 0.005$.

unaware or did not understand the reason for the presence of foreigners or thought that the foreigners were there to carry out deleterious activities such as the sale of blood. For example, participants from all communities told stories about the Amazonian myth of the "pishtacos," outsiders who killed local residents to sell their blood and fat.[22]

When asked specifically about the presence of foreigners providing health-care support, participants from all communities expressed positive opinions. They specifically mentioned the high quality of the medical equipment and medications provided by foreigners. In addition, participants had advice and requests to achieve successful, productive interactions between community members and foreign visitors. They requested that the visitors 1) provide clear and detailed information about what they plan to do, why, and for whom, 2) ensure that participation is voluntary, and 3) coordinate with community members and authorities. Participants also stated that foreign visitors should speak Spanish, to communicate effectively with community members. Finally, one leader underscored the importance of making interventions comprehensive and sustainable over time.

DISCUSSION

We assessed the health of children in four remote rural Amazonian communities as part of a baseline evaluation prior to a short-term humanitarian medical visit. We found a high prevalence of malnutrition, anemia, and intestinal parasites as well as a low rate of complete immunizations compared with rates reported for all the country.[4] Residents of all four communities had a similar spectrum of health problems despite differences in the size of the communities, health infrastructure, and access to health services. This was consistent with overall assessments conducted in rural communities of the Amazon Basin[23] and confirms that the sites selected for the HA activity were in need of these activities.[24]

TABLE 5
Health history of children < 5 years

Health issues	% (*n*/*N*)
Completed full Peruvian immunization schedule (> 1 year)	71 (235/330)
Sickness in the last 2 weeks	
Cough	49 (224/456)
Fever	34 (155/456)
Diarrhea	29 (130/456)
When my child had a cough	
I took my child to a MoH facility	60 (135/224)
I sought care or treatment on the first day	37 (82/224)
My child received care from a physician	45 (101/224)
When my child had a fever	
I took my child to a MoH facility	72 (111/155)
I sought care or treatment on the first day	57 (88/155)
My child received care from a physician	55 (85/155)
When my child had diarrhea	
I took my child to a MoH facility	35 (46/130)
I sought care or treatment on the first day	26 (34/130)
My child received care from a physician	25 (32/130)
Treatment of intestinal parasites in the last year	49 (225/456)

MoH = Ministry of Health.

The prevalence of stunting in our population was similar to that found in other studies,[24,25] especially those in the Amazon Basin.[26–29] We found a negative association between stunting and age, also similar to other studies in Peru and other Latin American countries.[26,28,30] Our study reported a lower prevalence of anemia compared with other studies in the same age group.[24,28,31] Among parasites, DNA-based methods demonstrated the absence of *E. histolytica* in this study population. The prevalence of geohelminths and *G. lamblia* was similar to those in other studies conducted in Peru, Latin America, Turkey, and Yemen,[26,29,32–35] in spite of the limitations of the direct observation and a unique stool sample for diagnosis of intestinal parasites. The findings regarding increased prevalence of intestinal polyparasitism and its relation with age were similar to other studies in the Peruvian highlands with children over 5 years of age.[36] However, a study in Cuba reported that rates of intestinal parasitism were not associated with a child's age.[37] All intestinal parasites increased after 1 year of age in our study; a similar correlation with age was found in studies in rural Ecuador and Ethiopia.[38,39]

According to their caretakers, over two-thirds of children between 1 and 4 years had received the full Peruvian immunization schedule. Other studies in resource-limited settings observed similar vaccination rates.[40,41] However, accurate estimation of vaccine coverage can be affected by recall bias and the inability of some caregivers to present their child's immunization card. Many of these vaccines require a cold chain or are given as a multidose series, two logistical hurdles that make achieving effective protection in remote communities challenging. Therefore, HA can be a valuable way to deliver single-dose vaccines that require cold storage such as yellow fever, particularly if using nonconventional cold-chain infrastructure. In addition, HA can serve to extend the coverage of multidose vaccines, such as hepatitis B, by including "immunization day" types of activities.

Anemia, intestinal parasites, and impoverished health infrastructure have both immediate and long-term consequences for

children's health. The observation of a high prevalence of various health problems in children 1–4 years highlights the importance of targeting health interventions at this group to combat their high burden of disease and malnutrition particularly (stunting and anemia). Also including children under 1 year as a target in these interventions could be beneficial for preventing conditions such as stunting, which may be more reversible at that age.[42] The non-detection of pediatric malaria is not unusual in this area, where incidence has been relatively low in the recent years.[43]

Our mixed-methods study characterized the baseline health needs of the communities and gauged how the local population, including health providers and heads of civil organizations, felt about their current health care as well as their opinions of foreign visitors and health-care personnel. Community members in Lagunas, a launching point for the Pacaya Samiria National Reserve, were not wary of outsiders, whether medical or nonmedical, whereas residents of smaller communities were concerned about the presence of outsiders in their communities. Nevertheless, participants did not feel threatened by foreign health-care personnel; instead, they associated these visitors with "better medicine," "better care," and "higher technology." A study conducted in the Democratic Republic of the Congo found similar positive perceptions in the population regarding health-care providers from humanitarian organizations.[44] However, such receptivity is not always present. A study in Sri Lanka showed that some beneficiaries were not completely satisfied with the distribution of goods by NGOs because they felt that HA personnel were not completely transparent and they did not fulfill their expectations, such as providing clean water and sanitation.[45] Therefore, HA should always include an assessment of the perspectives of potential direct beneficiaries such as community members and indirect beneficiaries such as health-care providers (MoH personnel), local authorities, and civil society organizations as a standard procedure for improving the delivery of such activities. Finally, U.S. Air Force personnel and in general personnel delivering HA interventions can also be indirect beneficiaries of the interventions because they improve their clinical skills, as reported in other HA activities.[10]

Short-term humanitarian medical visits, like those offered by the US-DoD and other organizations, represent an opportunity for populations in remote areas to receive health interventions in a short period of time.[46–48] Nevertheless, the challenge is providing care that is needed, effective, and safe. Short-term surgical HAs, focusing on correcting common childhood afflictions such as cleft palate or congenital urologic abnormalities, provide an obvious immediate benefit. However, they have been criticized for a lack of proper supervision of junior medical staff and absence of postoperative follow-up.[12] Nonsurgical medical HAs present different challenges, such as indiscriminant distribution of pharmaceuticals to a readily accepting population, which may introduce negative effects such as antimicrobial resistance, adverse drug reactions, or iatrogenesis due to a lack of adequate patient background knowledge.[14] Also, liberal distribution of medications by foreign entities can also reduce the local population's trust in local health-care providers. Therefore, comprehensive baseline evaluations, such as the one presented here, are critical for adequately assessing the needs of the local population, obtaining approval for planned activities, and coordinating the participation and support of local health-care providers. Careful planning and interaction with local, host country partners can help to maximize the benefits of HA and reduce unexpected, negative outcomes.[49] Overseas DoD laboratories such as NAMRU-6 are strategically located and can support MEDRETEs with accurate situational awareness, diverse assessment methods, and training of local staff. Their capacity building contributions can be valuable to this short-term HA activities and represent nonmeasured additional benefits of MEDRETEs.

The quantitative data identified several important public health problems in the local communities such as anemia, parasitism, decayed teeth, and low visual acuity. Some of these issues could be solved with one-time HA interventions improved HAs. In addition, we identified indicators such as the prevalence of anemia, prevalence of intestinal parasites, and immunization rates that would provide an easy way to measure the health of the target population before HA is delivered. Moreover, these indicators could be used as a baseline to measure the impact of future HA activities and could serve to establish goals according to characteristics of each HA intervention. The lack of non-intervened communities as a comparison group and the absence of some indicators in our survey such as chronic headaches related to decayed teeth may limit the accurate assessment of the impact of HA activities. However, even with these limitations, a similar post-HA assessment could be extremely valuable in understanding if HA can be a valuable public health tool.

In summary, our baseline visits uncovered two important facts in these four remote communities in the Amazon River basin. First, we noted health deficiencies that may be amenable to short-term health-care interventions. Second, we perceived openness to medical care provided by personnel from outside the community, including staff from foreign countries. These two observations indicate a possible role for future short-term humanitarian medical visits as an alternative to address the health-care needs of people living in remote locations, especially vulnerable populations such as children. Our findings highlight the importance of addressing the impact of HA on the inhabitants' perceptions of the local and visiting health-care personnel. Additional studies need to be conducted to determine whether such visits would result in tangible, objective improvements in health. We intend on carrying out future work to address these questions.

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