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## Anemia Management in Rural Haitian Children: A Mixed Methods Study

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# Anemia Management in Rural Haitian Children: A Mixed Methods Study

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## Abstract

**Introduction:** We examined factors influencing anemia outcomes in rural children following implementation of a prevention program. **Method:** Mixed methods study of children, parents, and clinicians utilized statistical modeling and content/ethnographic analysis. Retrospective chart abstraction evaluated treatments administered and measured hemoglobin in children aged 6 to 59 months ( $n = 161$ ). Prospective interviews/questionnaires examined parent ( $n = 51$ ) and clinician ( $n = 19$ ) perceptions. **Results:** Anemia prevalence decreased by 21.2%. Predictors of increased hemoglobin were clinic visit number and age at first visit. Once anemia improved, children were likely to remain improved ( $P = .65$ ). Despite favorable program perceptions, stakeholders emphasized ecological barriers, including social disadvantage and local practices. **Discussion:** Socioeconomic factors prevented guideline concordant behaviors. Persistent attention to intrapersonal, interpersonal, and community social determinants is a sine qua non for successfully managing the epidemic. The first step to provide culturally congruent care is to explicitly acknowledge that guideline-concordant behaviors are often complex.

## Keywords

anemia, social determinants of health, multilevel analysis, Haiti, disease prevention, primary, patient explanatory model, nutrition, water, sanitation, hygiene (WaSH), culturally congruent care, mixed methods

Haiti's anemia prevalence among preschool-age children (6-59 months) is the highest in the Western hemisphere (World Health Organization [WHO], 2015), with anemia reported for 66% of Haitian preschool-age children in 2017 (Holmes et al., 2017; Institut Haïtien de l'Enfance & ICF, 2018). This rate contrasts with global prevalence below 50% in preschool-age children and nearly 25% in school-age children (5-11 years; WHO, 2008). Anemia adversely affects child development, activity, immunity, and learning (Weppelmann et al., 2016), leading to neurodevelopmental deficits and psychiatric disorders in adulthood (Barks et al., 2019). Additionally, anemia contributes to under-five mortality rate.

Anemia persists despite decades of efforts to control it (Gage et al., 2017; WHO, 2015). Reasons for this persistence are not well understood. Evidence-based interventions for managing anemia in resource-poor settings exist (McLennan & Steele, 2016; WHO, 2015). However, geography and the lack of material resources prevent millions of Haitian families from accessing basic health care and social services (Gage et al., 2017). Local initiatives thus become crucial. Rigorous evaluation of local programs is vital to identify optimal practices and inform allocation of scarce resources (Centers for Disease Control and Prevention [CDC], 2016).

Determining the best approach starts with understanding the population and the determinants of health-related behaviors (Glanz, 2010). Cultural knowledge, awareness, and sensitivity help promote high quality health care for diverse populations (Clarke, 2017). The social ecological model (SEM; CDC, 2020) guided design of this study, providing a basis to conceptualize anemia determinants and management, and suggesting that in addition to genetics and biomedicine, a complex interplay of factors at multiple levels determine personal behavior and drive health outcomes. The levels of influence include individual, family,

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or social network (interpersonal), institutions/organizations (e.g., health clinics), the community (cultural values and norms), and public policy. The SEM considers behavioral theories and embraces the idea that behaviors both shape, and are shaped by, the social and cultural environment.

## Background

Genetic and biological causes of anemia include sickle cell disease and glucose-6-phosphate dehydrogenase (G6PD) deficiency (National Library of Medicine, 2019; WHO, 2011). However, the most common cause is nutritional deficiencies, mainly of iron and vitamin A, which are compounded by chronic blood loss from soil-transmitted helminth infections (iron-deficiency anemia; WHO, 2017a).

To address the complex problem, the Haiti Health Initiative and Inisyativ Sante Peyizan implemented the *Timo Anemia-Prevention Program* (TAPP) in March 2011 in Timo, a remote rural Haitian community. The TAPP is administered by clinicians during biannual outreach clinics (organizational level) and reflects evidence-based recommendations for nutritional anemia prevention (WHO, 2017a, 2017b, 2017c, 2017d). Individual interventions include hemoglobin (Hgb) measurements, in-clinic administration of vitamin A and albendazole (a deworming medication), and distribution of a 6-month supply of iron-rich multivitamins (MVIS). Nonpharmacological interventions provided at the family level include distribution of shoes and hygiene kits as well as education on nutrition and water, sanitation, and hygiene (WaSH) practices. At the community level, the TAPP partner organizations sponsored a clean water distribution project and public fountains.

Through 15 biannual outreach clinics between March 2011 and April 2018 (the time frame of this study), clinic personnel served 1,083 children aged 6 to 59 months who were living in or near Timo and found an overall anemia prevalence of 76.5% across that time span. The clinic encounters provided a relatively unique opportunity to study childhood anemia, anemia determinants, and changes over time.

The United States and Haiti have a long history of collaborating, and the United States provides substantial humanitarian assistance to Haiti (U.S. Department of State, 2020). Culturally congruent health care is caring that fits clients' lifestyle and values (Clarke, 2017). This study provides an illustrative exemplar of cultural factors that are particularly important for nurses engaged in humanitarian assistance and short-term medical initiatives (O'Handley & Erlinger, 2019; Steinke et al., 2015). Study findings may inform public health partners (government agencies, non-profit organizations, local communities), patient care providers, and health educators by enriching understanding about complex anemia problems, and through recommendations for anemia management in vulnerable populations.

## Study Purpose and Research Questions

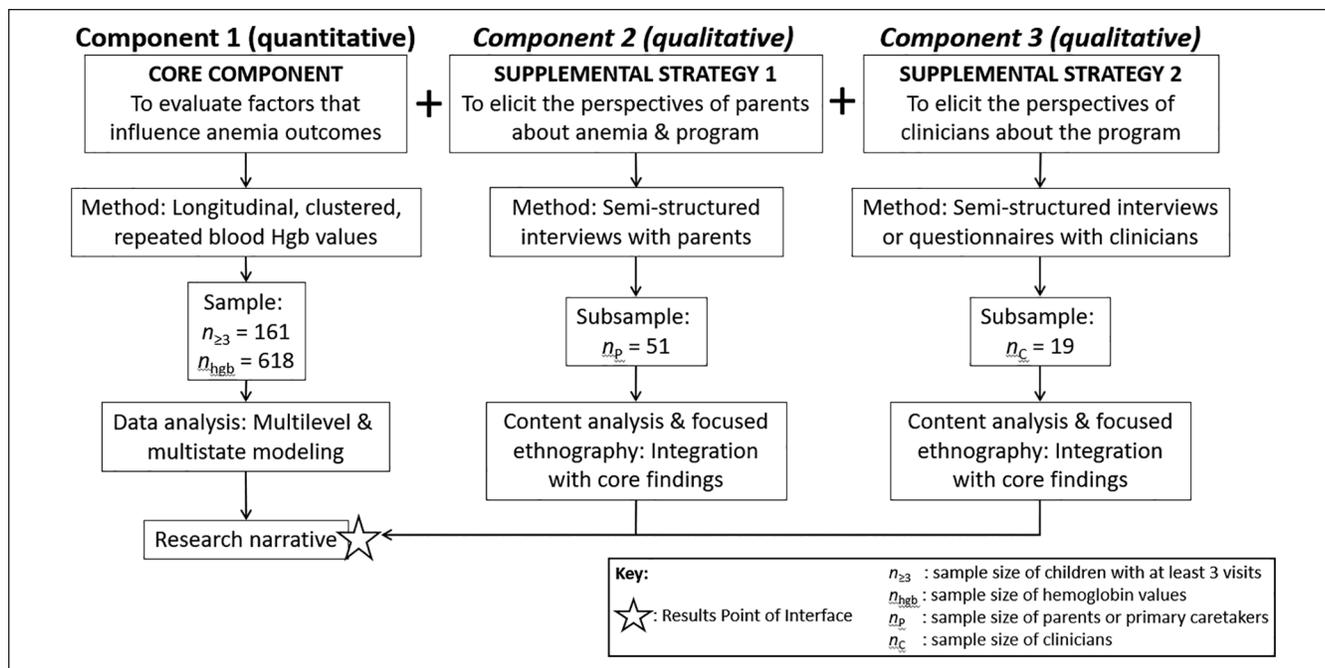
Guided by SEM, the study aimed to examine multiple levels of factors influencing outcomes in rural Haitian children following implementation of the TAPP. The central research question was: What factors contribute to anemia outcomes in children aged 6 to 59 months following the TAPP implementation? Interrelated study questions were:

1. How did each child's measured Hgb concentration change across time? (quantitative)
2. What quantifiable factors predicted changes in Hgb concentration? (quantitative)
3. What were the perceptions of parents or primary caretakers about anemia causation, treatment, and prevention-program factors? (qualitative)
4. What were the perceptions of clinicians about the TAPP implementation? (qualitative)
5. How do themes from parents and clinicians expand understanding of anemia management and observed Hgb patterns in the rural community? (mixed methods)

## Method

### Study Design

A mixed methods approach was chosen for purposes of (a) *expansion* (extending breadth and scope) to allow exploration of multiple levels of influence and (b) *triangulation* to assess the extent to which qualitative and quantitative findings corroborate each other (Morse, 2018; Shorten & Smith, 2017). The study used a *quantitatively driven, simultaneous mixed methods design*, with two supplemental qualitative components (Figure 1). Its theoretical drive is deductive (Schoonenboom & Johnson, 2017). Quantitative and qualitative data were collected concurrently, analyzed independently, then merged and integrated to create the research narrative as outlined by Morse and Neihaus (2009). Quantitative data were used to address questions about magnitude and measurable behaviors, and qualitative data were used to expand understanding and explore other influences. The quantitative component was a retrospective secondary analysis of medical records. Qualitative components were prospective assessments with key stakeholders (i.e., parents and clinicians), conducted during the months between clinic visits. Nurses need to understand the perceptions, practices, and values of those individuals they serve (Clarke, 2017). A *focused ethnography* perspective was chosen because ethnography explores phenomena from the point of view of study participants within the context of their culture. Focused ethnography has been used in nursing to understand experiences in the context of life situations (Wehbe-Alamah & McFarland, 2020). The lead investigator grew up in Haiti and, in 2007 as an adult public health nurse, began organizing biannual



**Figure 1.** Simultaneous mixed methods design.

outreach clinics and public health initiatives in the Timo community; thus, he had a long-standing and deep immersion in the local culture.

**Participants**

For the quantitative component (Study Questions 1 and 2), the population consisted of children aged 6 to 59 months who visited the biannual outreach clinics during March 2011 to April 2018. Children were included in the study sample if they visited the clinic at least three times and had at least one hemoglobin value which was verifiable in their patient medical record ( $n = 161$ ).

For the qualitative component involving parents (Question 3), the population comprised parents (or primary home caretakers) for children in the quantitative data set. Purposive sampling techniques were used to ensure data richness (McIntosh & Morse, 2015). Local research assistants and community leaders identified parents from different geographic areas, social roles, or who may have unique perspectives about the community. This sample comprised 51 parents.

For the qualitative component involving clinicians (Question 4), the population consisted of clinicians who participated in the TAPP program. These included Haitian and North American nursing personnel, Haitian community health workers, and North American pharmacists or pharmacy technicians. This sample consisted of 19 clinicians.

**Measures**

For the quantitative component, the dependent variable (health outcome) was anemia as reflected by the hemoglobin

value recorded in patient medical records. Anemia is diagnosed by a blood hemoglobin level below 11 g/dL, and further classified as severe (<7 g/dL), moderate (7-9.9 g/dL), or mild (10-10.9 g/dL; WHO, 2011). At the biannual clinics, children’s hemoglobin level was measured using a validated point-of-care machine (HemoCue) and reported as a continuous variable (e.g., 6.8 g/dL). For analyses, anemia severity was aggregated as high risk (severe or moderate anemia) or low risk (mild anemia or normal hemoglobin). Explanatory variables from the medical records included child demographics (age and gender), and clinic encounter information (visit date, and medications administered and dispensed).

Qualitative data from parents were obtained using in-person interviews conducted in Haitian Creole by Haitian research assistants. A semistructured interview instrument containing 44 items with probes was designed. The instrument included culturally oriented questions adapted from the *patient explanatory model* (Kleinman et al., 1978). Research personnel also recorded field notes and observations in the home during the interviews.

Qualitative data from clinicians were obtained using a semistructured interview tool consisting of 19 items with probes. In keeping with the preferences expressed by clinicians, the instrument was administered face-to-face in Haitian Creole to Haitian clinicians and as an online REDCap questionnaire with free-text responses administered in English to North American clinicians.

**Data Collection Procedures**

Quantitative data were collected through chart abstraction. Data generated during clinic encounters were recorded in a

**Table 1.** Descriptive Statistics of Categorical Patient Variables ( $n = 161$ ).

Variable	<i>n</i>	Percentage
<b>Gender</b>		
Female	75	46.6
Male	86	53.4
<b>Visits per child</b>		
3	59	36.6
4	42	26.1
5	28	17.4
6	14	8.7
7	10	6.2
8	4	2.5
9	4	2.5

paper medical record and transcribed to an electronic database. The database was verified by comparing the electronic file against the paper record.

Qualitative instruments were field tested with Haitians knowledgeable about the community and modified for clarity and to elicit study concepts in a culturally appropriate way (McIntosh & Morse, 2015). Participants were identified through the Haiti Health Initiative's electronic databases and contacted by phone, in-person, or via email to assess willingness to participate. Screening, enrollment, and consent occurred in homes or private locations chosen by participants. Interviews immediately followed and were digitally recorded and transcribed in Haitian Creole to preserve cultural and linguistic cues. Parent interviews and observations lasted on average 1 hour and clinician interviews lasted 25 minutes.

The study was approved by Haiti's National Bioethics Committee and the authors' university institutional review board. Approval included a waiver of informed consent for the secondary analysis of existing data and informed (verbal) consent, using a study cover letter.

### Data Analysis

Four data sets were produced (quantitative data, qualitative interviews with parents, qualitative interviews with clinicians, and online interviews with clinicians). Data sets were examined independently, then integrated following guidelines by Fetters et al. (2013).

Quantitative analysis was performed using R Version 3.5.3. Descriptive statistics of categorical (Table 1) and continuous patient variables (Table 2) and independent *t* tests characterized the sample and compared hemoglobin values between groups. Hemoglobin values for individual children were graphed as a trajectory and categorized into general patterns. Linear mixed effects models identified predictors of change in hemoglobin concentration over time. Mixed effects models (multilevel modeling) accounted for repeated measurements for the same child over multiple clinic visits

(Luke, 2020). A multilevel imputation method was used to replace incomplete data for some analyses, as suggested by Audigier et al. (2018). *Markov chain*, a multistate modeling technique (Komorowski & Raffa, 2016), analyzed the probability of changes between high-risk state (severe/moderate anemia) and low-risk state (mild/no anemia).

Qualitative analysis was performed using ATLAS.ti Version 7.5.18. A content analysis as described by McIntosh and Morse (2015) was performed. Interview transcripts were coded in Haitian Creole to preserve linguistic and cultural nuances. The codebook and coding system were developed in English prior to data collection and finalized during data analysis, following Morse's (2015) guidelines. An eclectic coding approach, as described by Saldaña (2015), was followed to explore a variety of phenomena from the data. Further analysis integrated field notes and observations. Clinician interviews and questionnaires were initially analyzed in the language used to capture the data (Haitian Creole or English), with codes (concepts, categories, or themes) represented in English. Exemplar statements were transcribed to English after analysis. Tables 3 and 4 present the sociodemographic characteristics for parents and clinicians. Following independent analyses, mixed methods integration used principles and procedures described by Morse and Niehaus (2009).

### Results

Results related to the interrelated research questions were woven together according to guidelines proposed by Guetterman et al. (2015), and the mixed methods study question. Consistent with the theoretical drive, quantitative results are displayed first, supplemented by explanatory themes emerging from qualitative analyses. Additional findings from qualitative questions (Questions 3 and 4) follow the main findings.

#### Overall Clinical Outcomes (Individual Level)

The first study question indicated overall improvement over time. Anemia prevalence decreased from 83.2% of children having anemia on their first-known hemoglobin measurement, to 62% of children having anemia on last-known measurement ( $p < .001$ ). Hemoglobin trajectories over time showed a distinct upward trend (improvement) in 61% ( $n = 96$ ) of children and relatively flat trajectory (stable, no worsening) in 24% ( $n = 38$ ). The remaining 15% ( $n = 24$ ) showed a downward trend (worsening anemia).

Qualitative perceptions corroborated quantitative findings. Parents perceived anemia as widespread and affecting quality of life for children. Parents described anemia as "blood drying up" or "lack of iron," leading to pain hiking in the mountains, missed school attendance, and apathy. Parents reported emotional and physical burden for themselves as they witnessed children sufferings and carried their incapacitated children from place to place.

**Table 2.** Descriptive Statistics of Continuous Patient Variables.

Variable	Patient count	Visit count	<i>M</i>	<i>SD</i>	<i>Mdn</i>	Minimum	Maximum
Age, months	161	707	31.3	14.9	31	6	59
Age at first visit, months	161	161	16	9.8	12	6	44
Hemoglobin, g/dL	161	618	10.1	1.4	10.3	5.7	16.1

**Table 3.** Parent Demographic Characteristics.

Demographic/group	Total sample summary ( <i>N</i> = 51)
Gender, <i>n</i> (%)	
Female	49 (98)
Male	2 (2)
No. of children <5 in household, <i>n</i> (%)	
1	28 (55)
2	17 (34)
3	5 (10)
4	1 (2)
Education, <i>n</i> (%)	
No school	3 (6)
Some elementary school	7 (14)
Some secondary school	8 (16)
Some college	33 (66)

### Anemia Predictors

Study Question 2 examined quantitative factors that predict changes in Hgb concentration. Factors related to clinic attendance and child demographic characteristics were evaluated separately. Parent (Question 3) and clinician (Question 4) perspectives related to those factors augmented understanding of the quantitative findings.

#### Clinic Predictors (Institutional Level)

In regression models, vitamin A, albendazole, and MVI did not show any effect, but the number of clinic visits over time was the strongest predictor of Hgb level. Multilevel models included 618 hemoglobin values for 161 children and showed hemoglobin increased by an average of 0.22 g/dL ( $p < .001$ ) per visit. Multistate modeling (Markov models) examined changes between clinic visits and reported the probability ( $P$ ) of having a specified anemia status (high or low risk) at the next visit. Markov models showed that the children who had a hemoglobin value in a low-risk category (normal or mild anemia) tended to remain low risk ( $P = .72$ ) at their next visit. Those who started in a high-risk category (moderate or severe anemia) were equally likely at the next visit to improve ( $P = .51$ ) or stay the same ( $P = .49$ ). Looking across five clinic visits, children who started in a high-risk category were more likely to move to a lower risk category ( $P = .65$ ), and more likely to remain low risk than to relapse ( $P = .65$ ), showing a distinct additive effect. The probability

of being in a low-risk state at next measurement was higher as the number of visits increased.

Stakeholder perspectives partially corroborated the quantitative results. Many parents reported anemia outcomes improved and perceived that the TAPP was valuable because it provided access to health services and pragmatic assistance as a supplement to education. A parent explained, “It is easy [to do what you’re asked to do at the clinics] because you don’t have to spend money in a hospital.” Another added, “They [encourage] you to put sandals on the child’s feet, they give you the . . . sandals; they [encourage] you to give her medicine, they give you [the] medication.” Conversely, some parents reported that long wait times at the clinics were deterrents and sometimes they left without receiving prescribed medications. Clinicians emphasized the opportunity for health education. One nurse explained, “children should come every six months to receive medicines, but parents have to [receive] good information about what to do; otherwise, it is like washing your hands and wiping them off on the floor.”

**Interface.** Both quantitative and qualitative data affirmed that the TAPP was vital in improving or stabilizing anemia. Clinicians shared ideas for promoting clinic attendance through case management and invitation to return for consecutive treatments (*Interpersonal level*).

#### Demographic Predictors (Individual Level)

Although a child’s sex was not predictive of Hgb level, age at the first clinic visit predicted increased Hgb concentration ( $p = .017$ ). Older children aged 36 to 59 months overall had a greater average hemoglobin (10.47, 95% CI [10.39, 10.55]) than younger children aged 6 to 35 months (9.89, 95% CI [9.75, 10.03]).

In the qualitative data, parents perceived that age was important, primarily because younger children’s selective eating behaviors and affinity for commercially produced snacks resulted in unbalanced food intake. Parents and clinicians recounted that younger children were more prone to “spit [out] the chalky-like substance,” which they attributed to the “gross” taste of the medication tablets. One mother said her child would only take the MVI in coffee. Clinicians believed that medication characteristics influenced ingestion. Liquid formulations were not available for young children. Albendazole tablets were difficult to dissolve, and a nurse explained that administering the exact dose to younger children was difficult.

**Table 4.** Clinician Demographic Characteristics.

Demographic group	Canada; n = 1 (5%)	Haiti; n = 7 (37%)	USA; n = 11 (58%)	Total; N = 19
<b>Gender, n (%)</b>				
Female	1 (5)	7 (37)	10 (58)	18 (95)
Male	0	0	1 (5)	1 (5)
<b>Data collection, n (%)</b>				
Interview	0	6 (32)	0	6 (32)
Online questionnaire	1 (5)	1 (5)	11 (58)	13 (68)
<b>Number of times worked in outreach clinics, n (%)</b>				
1	0	0	9 (47)	9 (47)
2-5	1 (5)	2 (11)	2 (11)	5 (27)
≥6	0	5 (26)	0	5 (26)
<b>Professional role, n (%)</b>				
Licensed registered nurse	1 (5)	0	5 (26)	6 (31)
Unlicensed nurse	0	5 (26)	0	5 (26)
Certified nursing assistant/technician	0	1 (5)	2 (11)	3 (16)
Licensed pharmacist	0	0	2 (11)	2 (11)
Licensed pharmacy technician	0	0	1 (5)	1 (5)
Licensed paramedic	0	0	1 (5)	1 (5)
Community health worker	0	1 (5)	0	1 (5)
<b>Education, n (%)</b>				
High school or less	0	2 (11)	2 (11)	4 (22)
Some college	0	1 (5)	0	1 (5)
2- or 4-year college degree	1 (5)	4 (21)	7 (37)	12 (63)
Graduate degree	0	0	2 (11)	2 (11)

*Interface.* Qualitative data corroborated quantitative findings that younger children may be at the greatest risk. They described barriers such as eating patterns and medication characteristics that might lead to subtherapeutic treatment, particularly, for younger children.

### Additional Findings

Quantitative models only predicted 17% of the variation in Hgb values. Thus, most anemia drivers (83%) were hypothesized to be influences that occur outside of the clinic visits. Qualitative study questions further explored parent (Question 3) and clinician (Question 4) perspectives about those influences.

### Ecological Predictors (Cultural, Community, and Public Policy Influences)

Qualitative findings underscore that environmental factors represent formidable barriers to behavior change. Traditionally, nonpharmacological anemia efforts have emphasized knowledge and skills. However, parents generally understood what they had been taught about anemia prevention. Parents explained that they knew about the food groups, but healthy foods were unaffordable because of unemployment and “nurses did not really know our funds . . . [which] may diminish our ability to follow what they told us.” While parents in Timo had clean spring water that was

pipled to a communal tap, many living further out in the countryside reported that contaminated river water was the only option. One parent described the water can “give you any kind of disease” and cause constant abdominal pain and itching: “We [drink it] because there is no water anywhere.”

Parents reported cultural practices that potentially hindered iron absorption. For example, families regularly consumed cornmeal, an iron-rich food. However, the iron in corn has low bioavailability. Additionally, some parents administered unsweetened coffee as a folk remedy to treat anemia or dissolved MVI in white coffee. However, coffee has long been known to decrease iron absorption (Kejo et al., 2018; Lopez et al., 2016).

*Interface.* The quantitative data suggested that Hgb levels may be mostly driven by factors beyond what happens in the clinics. Qualitative findings suggested socioeconomic barriers to following recommendations, despite general understanding of healthy principles and a desire for behavior change.

### Guideline (Non-)Concordance (Institutional, Interpersonal, and Individual Influences)

Guideline concordance metrics for clinicians showed that care may not always be congruent with TAPP recommendations. We examined adherence to the protocol for hemoglobin testing (87.4%), vitamin A and albendazole administration

(81.2%), MVI distribution (62.7%), and complete clinic bundle consisting of hemoglobin assessment plus all medications (55%).

In the qualitative data, clinicians reported seeing printed protocols at clinic stations and age-specific medication doses on the medical records. Explanations for deviation from protocols included inadequate supplies of medications, making weight-based medication decisions based on prior experience, clinical judgment to forego screening tests (skipping preventive actions because of acute illness, for example), and the personal understanding about the purpose of protocols.

Family behaviors and lifestyle (daily nutrition, WaSH) are also part of the TAPP guidelines. Examination of children's feet and observation of water filters, storage containers, and MVI bottles in the home showed a predisposition for children to walk barefoot on most occasions (increasing exposure to soil-born helminths), low adherence to water-storage guidelines, and low adherence to MVI instructions. Although parents had generally positive attitudes about MVI, feeling it was likely to be helpful, they sometimes received only a partial supply. Some parents thought that MVI was so important that they shared tablets with older siblings and adult family members, potentially leading to the under dosing of the children younger than 5 years. Several parents reported conflicting personal attitudes, beliefs, or habits. One mother stated, "We have . . . all the things that may have helped the child. . . . We do not value [or believe] them." Neighbors also influenced the extent to which protocol recommendations were followed. In certain *courtyards* (the local name for clusters of homes), it was the norm to drink untreated spring water due to shared beliefs that such water required no treatment since "God created the water." Although most parents were satisfied with the TAPP clinic processes, several reported that "treatment relief didn't last" and wondered about sickle cell disease, questioning the relevance of education and medications that assume nutritional deficiency.

**Interface.** The quantitative data showed various degrees of clinician fidelity to protocol, with the lowest adherence related to MVI supplements. Qualitative data revealed MVI shortages, and a variety of clinician and parent beliefs about the value of MVI. Qualitative data also uncovered personal and community barriers that prevent parents and families from following recommendations.

## Discussion

Over the course of the TAPP program, measurable outcomes improved, with parents reporting decreased symptomatology in their children. There was likely an additive effect of multiple episodes of care. However, only 15% of children younger than 5 years had at least three visits. For parents, regular attendance was influenced by institutional and interpersonal processes such as waiting time, invitations, and reminders. Previous studies have shown that reminders can

increase clinic attendance, facilitate behavior change, and improve health outcomes (Crutchfield & Kistler, 2017; Percac-Lima et al., 2016; Teo et al., 2017).

Anemia will likely persist unless social determinants are addressed. Improving nutrition, access to clean water, and sanitation may be even more important than pharmacological interventions. Children younger than 2 years are predisposed to vitamin deficiencies (Treas et al., 2018) and this study similarly found children 2 to 3 years of age were at risk. Supplying fortified foods may be beneficial (Iannotti et al., 2016). Local and international partners should support Haiti's government in implementing food fortification laws, promote use of fortified foods, and collaborate to expand the National School Meals Program to remote rural communities. Although the UN asserts access to clean water as a human right, Haiti occupies the 156th position out of 162 nations in achieving Sustainable Development Goals (Sachs et al., 2019). Efforts to improve nutrition and WaSH should continue (Dube et al., 2018).

Issues related to guideline-concordant behaviors must not be overlooked. Care providers and health educators should acknowledge that social disadvantage may prohibit adherence to recommendations and discuss culturally relevant and locally available alternatives. Tailored community education should explore locally acceptable ways to increase protein consumption such as cooking techniques that increase iron bioavailability. Communication and support could capitalize on the existing microsystems (i.e., courtyards) to reinforce interventions.

Study strengths included mixed methods, with qualitative findings expanding understanding and, in some cases, uncovering possible explanations for quantitative findings. The study could not definitively pinpoint the factors leading to persistent low hemoglobin values. Qualitative data were prospective and recorded only once whereas the quantitative data were retrospective and spanned several years. Parent interviews and observations were recorded anonymously, and so qualitative responses could not be linked to specific children to inform the statistical models. These limitations may inform subsequent studies.

## Conclusion

This study found that multifaceted anemia management approaches can be effective despite resource limitations. A root cause of persistent high anemia in rural Haitian children may be barriers related to social disadvantage, preventing protective behaviors. Persistent commitment at all levels is a sine qua non for managing childhood anemia. Further research is needed to understand protective factors in non-anemic children and to develop therapeutics that are safe, practical, acceptable, and climate appropriate. Modern approaches, including apps and other technology, may extend the reach of care and counseling interventions (Percac-Lima et al., 2016; U.N. Children's Fund, 2020; Yen & Leasure, 2019).

Transcultural health-care providers can provide culturally congruent care and improve health outcomes by creating mutually acceptable and culturally relevant programs (Clarke, 2017). To accomplish this, they must (a) explicitly acknowledge to clients that guideline-concordant behaviors are often complex, (b) discuss with compassion and sensitivity the impact of cultural practices on health outcomes, (c) carefully explore feasible alternatives for behavior change, and (d) proactively adjust clinic protocols, workflows, and processes to meet local needs. New public-private partnerships should include local and lesser known organizations and successful innovations must be developed for reaching the most vulnerable populations in need of evidence-based interventions.

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