Awareness, Attitude and Practice of Paediatricians in Relation to Helicobacter Pylori Infection Diagnosis and Management in Rwanda

By

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Declaration

The researcher:

"I hereby declare that this dissertation **"Awareness, Attitude and Practice of Paediatricians in Relation to Helicobacter Pylori infection Diagnosis and Management in Rwanda"** is my own work and it has not been submitted by any other university for the award of a degree."

Signed

Date 28/12/2022

Dr Emmanuel Nubahumpatse

The supervisor:

"I hereby declare that this dissertation **"Awareness, Attitude and Practice of Paediatricians in Relation to Helicobacter Pylori infection Diagnosis and Management in Rwanda"** was submitted by Dr. Emmanuel Nubahumpatse

Signed

Date 28/12/2022

Dr Jean Claude Kabayiza, MD, MMED, PhD

Dedication

To my family

Acknowledgment

"Thanks to the Almighty God for helping me in the completion of this study and having good health throughout the period of my studies.

My high gratitude goes to the Emory University School of medicine Division of oral and maxillofacial surgery anonymous donor and Middlesex health special education and quality improvement fund who provided partial financial support to cover statistical expenses

I would love to further thank my parents and family for their support and care.

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Abstract

Background

Helicobacter pylori infections (HPI) are a global public health problem, believed to cause more than 300,000 deaths each year. The prevalence is disproportionately higher in developing countries. In Rwanda, it is found in 80% of adult patients with gastritis at the University Teaching Hospital of Kigali. The infection starts during early childhood, making the utilization and adherence to evidence-based guidelines among paediatricians critical for diagnosis and management. This study explores the awareness attitudes and practice of paediatricians regarding the diagnosis and management of HPI in Rwanda.

Methodology

This was a descriptive cross-sectional study conducted from May to June 2022 in Rwanda. Among eighty registered paediatricians, 66 were recruited based on a simple random sampling approach. A self-administered questionnaire was distributed by the lead researcher. Data were analyzed using SPSS software and a p-value of ≤ 0.05 was considered significant.

The study was approved by the institutional review board of the University of Rwanda.

Results

Among sixty-six recruited participants, 72.7% were male, 87.9% were general paediatricians, and 90.9% were primarily employed in the public sector. More than half (57.6%) initiate testing from 5-12 years of child's age, 86.4% treat the infection after investigation and the most requested investigations were: stool antigen (90.6%), serology test (46.9%), and endoscopic exam (31.3%). Participants from public institutions were more likely to utilize stool antigen (90.0% vs 50.0%, OR:1.800, p=0.006) and less likely to utilize serology tests (40.0% vs 83.3%, OR:0.480, p=0.041). The majority (93.8%) supported that guideline-informed management would minimize diagnostic errors and promote the appropriate treatment. All participants and 93.1% respectively from the private and public sectors were in agreement with the role of guideline-informed management in quality care. Highlighted sources of information were medical journals (78.8%), internet sources (56.1%), and NASPGHAN (19.7%). All participants reported treating HPI with antibiotics plus proton-pump inhibitors. The antibiotics of choice were always amoxicillin plus either clarithromycin (59.1%) or another antibiotic (40.9%). Only 56.1% were adherent to a 14-day regimen prescription. Confirmation for eradication was by both clinical and control tests (12.1%) or by either alone (87.9%). Participants with the rank of consultant or beyond were more adherent to a 14-day antibiotic

regimen than junior consultants (55.0% vs 26.9%, OR:1.624, p=0.025). Participants with more than five years of experience were more likely to combine clinical and investigation tests to confirm eradication than their counterpart juniors who were more likely to utilize either alone (23.8% vs 6.7%, OR:1.225, p=0.047).

Conclusions

Rwandan paediatricians are aware of the current evidence on *H. pylori* and are willing to utilize evidence-based guidelines. The results express a need to institutionalize the existing evidence on HPI among the paediatric population and a need to promote continuous medical education for capacity building of the paediatricians. Where possible, hospitals should create and sustain the inter-facility agreement to utilize the existing minimum capacity, with the aim to serve the maximum number of patients, as stated by Sustainable Development Goal 17.

Keywords: Children, Helicobacter pylori, paediatricians, Diagnosis, Management, Rwanda

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Abbreviations and Acronyms

CHUB : University Teaching Hospital of Butare

CHUK : University Teaching Hospital of Kigali

ESPGHAN : European Society for Pediatric Gastroenterology Hepatology and Nutrition

H. pylori : Helicobacter pylori

HPI : Helicobacter Pylori infection

IRB : Institutional Review Board

ITP : Idiopathic Thrombotic Purpura

LIC : Low-Income Country

MALT : Mucosa-associated lymphoid tissue

MIC : Middle Income Country

MOH : Ministry of Health

NASPGHN : North American Society for Pediatric Gastroenterology, Hepatology, and Nutrition

PCR : Polymerase chain reaction

PI : Primary investigator

PPI : Proton pump inhibitors

RPA : Rwanda Paediatric Association

UR : University of Rwanda

WHO : World Health Organization

CHAPTER I. INTRODUCTION

1.1 Background

Helicobacter pylori (H. pylori), One of the most prevalent illnesses in the world today, which affects half of the global population, has become a global public health issue (1–3). Annually, H. pylori infection (HPI) is connected to more than 300000 deaths (1,4) and it is classed as a "class I carcinogen" by the World Health Organization (WHO)(5,6).

The prevalence of HPI varies from country to country but it is reported to range from 20% to 90%, with disproportionately higher prevalence in low- and middle-income countries (LMIC) relative to high-income countries (HIC) (7,8). Regardless, the key factors that were reported to increase the risk for HPI in both HIC and LMIC were often correlated with the socioeconomic status of the households, overcrowding in housing, the number of people in the family, and older siblings (9,10). Although HPI affects half of the world's population, its prevalence in Africa is estimated to be as high as 80% and the infection is contracted during childhood(3,8). A retrospective descriptive study conducted among adult patients aged between 15 to 92 years at the University Teaching Hospital of Kigali (CHUK) from 2016 to 2018 reported that the prevalence of HPI was 80.2% and 75.8% in chronic gastritis and gastric adenocarcinoma, respectively (11).

The use of evidence-based guidelines developed based on studies with well-controlled methodologies is documented to enhance safe and optimal treatment with good clinical outcomes(12). However, the utilization and adherence to these guidelines by primary care pediatricians remain unclear in the management of HPI. Primary-care pediatricians differ based on their educational background, sub-specialty training, and professional experience (13). Parents typically consult their primary care doctors and general practitioners initially about their children's health, including issues related to HPI. Therefore, it is important that primary care physicians have the appropriate knowledge to make adequate decisions and prevent incorrect practices that may otherwise result in elevated costs without additional health benefits for the population (14). Furthermore, the lack of data would lead to an incomplete picture of HPI linked to other various encounters comprising inadequate healthcare system, and a lack of standardized clinical protocol for diagnosis and management (15).

1.2. Problem statement

The diagnosis and management of HPI among the paediatric population in Africa remain a challenge that opens a need for an evidence-based consensus (1). Questions related to the clinical presentation of HPI and diagnostic approaches to help clinicians decide on what type of treatment is appropriate to have been raised over decades(16). The existing guidelines and recommendations have reflected on specific situations based on the prevalence burden of the infection in LMIC, the limited resources at health facilities, and the residence in the pharmacological therapy (17).

Although HPI may be contaminated during childhood, the affected child may have no symptoms but still exhibit long-term complications including gastritis with or without ulcer and, to a more severe extent, gastric cancer (18). There is a paucity of treatment guidelines among the pediatric and adolescent population in LMIC, yet, these guidelines are needed by healthcare professionals to ensure the provision of quality care based on correct diagnosis-based management among children with(19). Given this paucity of guidelines based on community-specific data, there is a need for healthcare professionals to utilize the already developed guidelines by recognized professional organizations and adapt them to the context of their communities. However, there is a lack of provider adherence to the utilization of clinical guidelines which leads to poor management of HPI in their respective pediatric patients.

A previous research done in Israeli reported that only 34% of paediatricians were using clinical guidelines developed by professional organizations for the management of HPI, and the study concluded that the adherence to the utilization of guidelines was low, and recommended educational intervention to bridge the gap and enhance quality care by the “primary-care pediatricians” for children with HPI (20). No data exists in Rwanda regarding the awareness, attitude, and practice of Rwandan paediatricians on the management of HPI which leaves a gap to be filled by research. The aim of this study was to explore the awareness, attitudes, and practice of paediatricians on the diagnosis and management of HPI in Rwanda and to document the disparities in practice based on the paediatricians’ workplace and experience.

1.3 Research aims and Objectives

1.3.1 General objectives

The objective of this study was to explore the awareness, attitudes, and practices of paediatricians on the diagnosis and management of HPI in Rwanda.

1.3.2 The specific objectives

1. To identify the age at which paediatricians most commonly begin to diagnose and treat HPI in Rwanda
2. To determine the proportion of all paediatricians in Rwanda who believe that guideline-informed management of HPI would minimize diagnostic error and promote appropriate treatment.
3. To identify the percentage of paediatricians in Rwanda who use guidelines to manage HPI
4. To evaluate the practice of paediatricians based on their working location, and clinical experience to promote the creation of evidence-based guidelines on diagnosis and management of HPI adapted to the Rwandan context

CHAPTER II. LITERATURE REVIEW

2.1 Literature Search

Helicobacter pylorus is a gram-negative bacterial infectious agent with an inter-human transmission pattern that always causes active chronic gastritis (21). This may lead to long-term gastric complications including gastric neoplasm such as gastric cancer, and MALT (mucosa-associated lymphoid tissue). H. pylori eradication heals gastritis and may help avoid long-term complications and reinfection. Therefore, H. pylori are considered an infectious disease irrespective of the clinical symptoms and complications (22).

2.1.1. Risk factors of Helicobacter Pylori

H. pylori is related to various gastrointestinal diseases and is a frequently encountered disease in the tropical region where human-to-human contact is the main form of disease transmission (23). Furthermore, a lower level of socioeconomic status is a major risk factor for HPI (24–26). Here we mention some of the factors associated with H. pylori:

Socioeconomic and educational status of parents: There have been claims over decades about the association between HPI and low socio-economic status. The studies conducted among Israeli children have demonstrated the association between HPI and low-socioeconomic status and similar findings were reported from Pakistan(20,27). It was further emphasized in a study conducted in Turkey among children without symptoms and their mothers which showed a positive association between HPI development and lower family income(28). Moreover, research done in the “Eastern Cape of South Africa” demonstrated a linkage between higher socioeconomic status and the development of HPI(26). People with low socioeconomic status are likely to consume contaminated water and food which increases the risk of HPI through the fecal-oral transmission route(26,29,30).

Age: An increasing prevalence of HPI was observed as a linear association with increasing age in a study conducted in South Africa, Nigeria, Uganda, Iran, and Germany. This finding has been explained as the age increases the rate of acquisition and reinfection decreases due to sanitation, education, and improved lifestyle (31). Then again, the prevalence was related to decreasing age as was described by authors in Nigeria, Iran, and Germany (32,33).

Overcrowding and the high number of siblings: The higher prevalence is reported in people living in overcrowded communities and a higher number of siblings due to the interpersonal spread of infection (1,34). Research done in Egypt revealed that the prevalence of HPI among

school-age children living in overcrowded homes was 72.4% when compared to a lower prevalence of 6.1% and 7.2% in young German girls and boys respectively, residing in less crowded homes (8,35,36).

2.1.2. Transmission of H. Pylori

Two modes of transmission have been proposed fecal-oral and oral-oral transmission. While the familial type of transmission is common, the horizontal transmission also occurs between persons outside of the same household, if there is a high prevalence of HPI in the country(23).

2.1.3. Prevalence of H. pylori in Africa

The epidemiology of HPI is variable since the occurrence is significantly higher and starts at early ages in LMICs compared to HICs (12,37). The lack of studies in African countries has left a restriction on data on HPI prevalence (23).

In a systematic review of studies published in 184 countries between 1970 to 2016, Africa had the highest prevalence of HPI (70.1%), followed by South America (69.4%) and Western Asia (66.6%) (6). The countries with the highest prevalence of HPI in the world and in Africa were Nigeria (87.7%), then Portugal (86.4%), and Estonia (82.5%) (6,32).

In East Africa, a study done in Kenya found that for patients who consulted for dyspepsia, HPI prevalence was 73.3% in children versus 54.8% in adults (26). In Uganda, a study reported an H. pylori prevalence of 44.3% in healthy children aged 0-12 years, who has infection risk factors like low socioeconomic status and poor hygienic diet (31).

In the Southern province of Rwanda, Timothy et al found that 75% of patients attending the University Teaching Hospital of Butare (CHUB) in one year were H. pylori positive, whereas in Burundi the prevalence was 70.8%(15,38).

2.1.4. Diagnosis of Helicobacter pylori in children

While there are different approved methods for diagnosing H pylori, usually categorized on whether they are non-invasive, minimally invasive, or invasive methods, the noninvasive methods usually require samples like blood, saliva, stool, urine, or breath for detection of H pylori antigen, antibody or urease activity(34). The invasive methods are with upper gastro-intestinal endoscopy with sample for biopsy (19). The best investigation would be one that is noninvasive or minimally invasive, with low cost, and availability, and that allows one to differentiate whether it is an active infection or past infection (39). The main challenge with

the paediatric population is that the age of the child may influence the accuracy of a test. It is necessary to consider different age groups such as infants, toddlers, preschool and school-aged children, and adolescents (19)(40). The test and treat strategy involve the delivery of H. pylori eradication therapy based on positive results of a noninvasive test, such as the H. pylori breath test or stool antigen test. Polymerase chain reaction (PCR) is advantageous to other methods since it gives detects the infection and gives details on the resistance to clarithromycin and/or levofloxacin while other tests simply recognize the infection (1).

2.1.5. Management of H. pylori in children

The course of management of H pylori takes 7 to 14 days using the combination of an anti-gastric acid secretion agent and two antibiotics. 14 days regimen was recommended by the "North American Society for Pediatric Gastroenterology, Hepatology, and Nutrition (NASPGHAN)" and the "American Academy of Pediatrics" (17), and The use of PPI/amoxicillin/clarithromycin or an imidazole or bismuth salts, amoxicillin, and imidazole or sequential therapy were recommended as the first-line regimen for H pylori eradication (20).

Moreover, current recommendations do not support testing asymptomatic children, living in areas where the prevalence of HPI is high because of the risk of reinfection unless there is evidence of gastric atrophy (7,41). Unfortunately, there are Children that continue to have persistent H pylori infection regardless of the triple therapy regimen, such children should be assessed for predictors of treatment failure, especially compliance with medication. Some children have H pylori-resistant strains which are also among the main reasons for treatment failure and so should always be remembered in children with persistent infections. In Rwanda, a study done by Kabakambira et al demonstrated the efficacy of a pragmatic H. pylori treatment regimen with a treatment success rate of 80% in general and 78% in those who have never taken triple therapy before (38).

The executive council of NASPGN and the American Academy of Paediatrics have endorsed these recommendations for HPI diagnosis and treatment but are only guidelines and not substitutes for clinical judgment or protocol in managing all patients (42).

CHAPTER III. METHODOLOGY

3.1. Study Description

To facilitate a rich description of the awareness, attitude, and practice of paediatricians in relation to HPI diagnosis and management in Rwanda, we used a questionnaire, and the participants were reached out to fill out the questionnaire for themselves (a self-administered questionnaire). PI (principal investigator) found the paediatricians at their places of work (private and public) at their convenient time. We approached all paediatricians in Rwanda, and all those willing to participate in the study were included until we reached the calculated sample size.

3.2. Study design

This was a descriptive, cross-sectional study to assess the awareness, attitude, and practice of pediatricians in relation to HPI in children in Rwanda

3.3. Study site

The study was conducted in paediatric departments of both private and public health facilities in Rwanda with pediatricians. We reached out to licensed pediatricians from their respective workplaces in private and public health facilities.

3.4. Study population

Participants were licensed pediatricians working in public or private facilities in Rwanda

3.3.1. Inclusion criteria

We included pediatricians who were willing to participate in the study.

3.4.2. Exclusion criteria

- Participants who are part of the research team.
- Pediatricians directly involved in the study
- Participants in a health condition would not allow to participate in conscious responses.

3.5. Sample size calculation

The sample size for a study to estimate the sample size when sampling from a small population, was calculated as follows:

$$n= N \times n'/ (N + n')$$

Where:

n = corrected sample size

n' = sample size for the large population *(as calculated*

from n'= $Z^2 \frac{p\,(1-p)}{e2}$ which is the formula to estimate the proportion of a population

N = Total population size

Thus, N=80 (number of active Paediatricians involved in the clinical setting in Rwanda)

n'= $3.84\frac{0.5\,(1-0.5)}{0.0025}$= 384

n'= the minimum required sample size from a large population.

Z= the standard normal value corresponding to a 95% confidence interval equal to 1.96.

p= the estimated proportion of pediatricians with good knowledge of H. Pylori management is estimated to be 50% as there is no previously known proportion.

e= level of precision set at 5%.

Thus, n= 80*384/ (80+384) = 66

3.6. Sampling Procedure

To obtain the list of paediatricians in the country, a list was requested from the Rwanda Pediatrics Association, which is the largest association that encompasses all pediatricians in Rwanda. A simple random sampling technique was then applied based on ascending alphabetical sorting by the first name of the paediatricians. This technique eliminated the sampling bias by which the researcher would just recruit data from the pediatricians in one place or who are just close to him and hence fail to represent other health institutions. The first sixty-six pediatricians were then contacted via email and contact phone for an appointment to receive an explanation about the study which attracted their interest to participate in the study. If a paediatrician among the first sixty-six is not reachable or does not accept to participate in the study within the study period, the paediatrician next on the list was contacted to participate in the study.

3.7. Data Collection Methodology

After explaining the purpose of the study to the participant, he/she was asked to sign a consent form to participate in the study before providing the questionnaire. Data were collected by the lead researcher using a self-administered questionnaire. For better utilization of time and resources, each participant was given options to participate by filling out a printed questionnaire or by filling out the online version of the same questionnaire. A questionnaire (both digital and printed) was then distributed according to the participant's choice. After

distributing the questionnaire, the participant had the right to respond immediately or later at his/her convenient time.

The filled questionnaires were collected three days after the initial distribution by the lead researcher or at the convenient appointment planned by the participants. Similarly, participants who opted for the digital questionnaire, either fill it out immediately or at any time of their choice. A reminder phone call was placed after three days requesting the participant to submit his/her filled form. As part of confidentiality, all forms were de-identified at the time of submission with no possibility to track the participant.

The survey asked questions about the respondents' personal demographic information, the criteria used to test for HPI, the use and selection of diagnostic tests, the criteria used to treat HPI, the choice of the treatment regimen, the respondents' awareness of prescription rates, and the sources of information they were familiar with regarding HPI. Due to the lack of an HPI awareness, attitude, and practice evaluation tool, especially for high-risk populations, a tool was made using the world health organization for creating knowledge, attitude, and practice survey (43).

3.8. Data analysis

Once a database had been created in Microsoft Excel® using the obtained data, it was then imported to IBM SPSS version 25 for analysis. The chi-square test was used to analyze the association between outcomes and predictors/risk variables. Categorical data were displayed using frequencies and percentages in tables and charts, while continuous data were summarized by means and median values based on their distribution. With a p-value of 0.05 or below, relationships were considered statistically significant. We looked at paediatricians' general replies as well as the subgroups by demographic traits.

We created a dichotomous variable for several Likert scale survey items by merging categories as agree (for agree and strongly agree) and disagree (for disagree and strongly disagree)**.**

3.9. Ethical considerations

The proposed study complies with the ethical principles of research. The study protocol was reviewed and approved by the University of Rwanda Institutional Review Board (IRB) No 350/ CMHS IRB / 2022. The local ethical committee where applicable were also contacted and application for approval were made before data collection, EC/CHUK/097/2022

3.9.1. Funding and sponsors

This study was partially funded by an anonymous from Emory university school of medicine division of Oral and maxillofacial surgery donor and Middlesex health special education and quality improvement fund who provided partial financial support to cover statistical expenses.

3.9.2. Potential conflict of interest

The author declares no competing interest in this study.

CHAPTER IV. RESULTS

There are eighty paediatricians in Rwanda involved in the clinical setting among them sixty-six pediatricians were recruited in this study.

4.1. Sociodemographic characteristics of the study participants

During this study, a total of sixty-six paediatricians were recruited and responded to the research questions. The majority were male representing 72.7%, with no other additional training beyond the MMED degree (87.9%). Most of the respondents were primarily employed in public health institutions (90.9%) with less than 10% revealing to be in private health institutions. Additionally, more than a quarter (27.3%) were revealed to be employed in both public and private health institutions. The details on socio-demographic characteristics and respondents' time repartition in public and private health institutions are presented in table 1

Table 1: Sociodemographic characteristics of study participants

Variables		N	%
Sex (N=66)	Male	48	72.7
	Female	18	27.3
Level of education (N=66)	MMED	58	87.9
	FCPAEDS + MSc	1	1.5
	Subspecialty	4	6.1
	PhD	3	4.5
Working Place (N=66)	Public	60	90.9
	Private	6	9.1
Title (N=66)	Junior consultant	28	42.4
	Consultant	27	40.9
	Senior consultant	9	13.6
	Chief Consultant	1	1.5
	Other paediatric sub-specialty	1	1.5
Job experience (N=66)	0-5 years	45	68.2
	5-10 years	14	21.2
	10-15 years	5	7.6
	15-20 years	2	3
Time dedicated to public facility (N=60)	0-25%	4	6.7
	25-50%	1	1.7
	50-75%	8	13.3
	75-100%	47	78.3
Time dedicated to Privatefacility (N=39)	0-25%	30	76.9
	25-50%	4	10.3
	50-75%	1	2.6
	75-100%	4	10.3

Dual practice (N=66)	Yes	48	72.7
	No	18	27.3

4.2 Age at which paediatricians commonly begin to diagnose and treat HPI in Rwanda

Most participants, 38 (57.6%), reported that they initiate HPI testing among children aged five to twelve years of age, 36.4% reported from one to five years, 3.0% reported infancy period below one year of age, and 3.0% reported above twelve years as the earliest age they start testing and treating HPI in children. Across all the groups, the age category of five to twelve years was consistently reported as the most common child period where paediatricians initiate testing and treating HPI. However, all respondents from private health institutions, participants with additional training beyond general paediatrics, participants with more than five years of experience, and participants with consultant titles and beyond have all reported initiating testing and treatment before the child reaches the age of twelve years while 1.9-7.7% of their counterparts reported initiating the tests beyond twelve years of age. Table 2 represents the details of the earliest age at which paediatricians commonly begin to diagnose and treat HPI in Rwanda.

Table 2: Age at which paediatricians commonly begin to diagnose and treat HPI in Rwanda

		Earliest patient age for testing and treating HPI			
		Infants	1 to 5 years	5 to 12 years	>12 years
Working Place	Public	1 (1.7)	22 (36.7)	35 (58.3)	2 (3.3)
	Private	1 (16.7)	2 (33.3)	3 (50)	0 (0)
Additional training	Yes	1 (12.5)	1 (12.5)	6 (75)	0 (0)
	No	1 (1.7)	23 (39.7)	32 (55.2)	2 (3.4)
Title	Junior consultant	1 (3.8)	7 (26.9)	16 (61.5)	2 (7.7)
	Consultant and beyond	1 (2.5)	17 (42.5)	22 (55)	0 (0)
Experience	0-5 years	1 (2.2)	20 (44.4)	22 (48.9)	2 (4.4)
	> 5 years	1 (4.8)	4 (19)	16 (76.2)	0 (0)
Reads journals	Yes	1 (1.9)	20 (37.7)	31 (58.5)	1 (1.9)
	No	1 (7.7)	4 (30.8)	7 (53.8)	1 (7.7)
Total		**2 (3.0)**	**24 (36.4)**	**38 (57.6)**	**2 (3)**

The participants in this study had had different experiences with HPI in children and the available modalities to diagnose HPI as presented in table 3. The largest proportion (86.4%) of participants reported that they treat HPI after ordering investigations for the infection while 13.6% reported it as not their practice. Regarding the diagnostic tests used, 58 (90.6%) and 30 (46.9%) reported that they order stool and serology antigen tests respectively even though these

tests were available at the workplace among only 47 (71.2%) and 5 (7.6%) respectively. Furthermore, 20 (31.3%) requests for the endoscopic exam even though it was reported as available at the workplace among only 10 (15.2%). The urea breath test was the least used by 3 (4.7%). In exploring the paediatrician's particular experience with HPI among under 5 years children, more than one-third (36.4%) reported that up to 10% of children who develop HPI symptoms before the age of 5 years eventually become adolescents or adults with complications of the infection, while 16.7% reported this occurrence to be as high as 11 to 25%.

Table 3: Participants reported experience with HPI in children

Variable		**N**	**%**
Orders investigation for HPI diagnosis	Yes	57	86.4
	No	9	13.6
At what earliest patient's age do you start testing and treating HPI in children	Infants	2	3.0
	1 to 5 years	24	36.4
	5 to 12 years	38	57.6
	>12 years	2	3.0
Available and effective diagnostic tests for HPI	Endoscopy	10	15.2
	Serologic	5	7.6
	Stool antigen	47	71.2
	UBT test	4	6.1
Investigations requested	Endoscopy	20	31.3
	Serology	30	46.9
	Stool antigen	58	90.6
	UBT	3	4.7
In your experience, what is the percentage of children under five who have new onset of HPI symptoms who become adolescents or adults with complications of HPI	0-10%	24	36.4
	11-25%	11	16.7
	26-50%	2	3.0
	No idea	29	43.9

4.3. The proportion of Paediatricians who believe that guideline-informed management of HPI would minimize diagnostic error and promote appropriate treatment

The participants' responses on their belief regarding guideline-informed management of HPI as a route to minimize diagnostic errors and promote appropriate treatment are presented in table 4. The biggest proportion (93.8%) of respondents supported that guideline-informed management would minimize diagnostic errors and promote the appropriate treatment for HPI while the remainder disagreed or strongly disagreed with the statement. All participants (100%) and 93.1% respectively from private and public health facilities were in positive agreement

with the role of guideline-informed management in the reduction of diagnostic errors and promotion of appropriate care.

Table 4: Participants' attitude on guideline-informed management as a route of minimizing diagnostic error and promoting appropriate treatment

		GIM would minimize diagnostic error and promote appropriate treatment for HPI, N (%)	
		Agree	Disagree
Working Place	Public	54 (93.1)	4 (6.9)
	Private	6 (100)	0 (0)
Additional training	Yes	6 (85.7)	1 (14.3)
	No	54 (94.7)	3 (5.3)
Title	Junior consultant	24 (92.3)	2 (7.7)
	Consultant and beyond	36 (94.7)	2 (5.3)
Experience	0-5 years	42 (93.3)	3 (6.7)
	> 5 years	18 (94.7)	1 (5.3)
Reads journals	Yes	49 (94.2)	3 (5.8)
	No	11 (91.7)	1 (8.3)
Total		**60 (93.8)**	**4 (6.3)**

GIM: Guideline-informed management

The responses to other attitude questions regarding HPI management are presented in table 5. By the time of our data collection, 51 (78.5%) agreed or strongly agreed that quality guidelines were sufficiently available for the management of HPI. However, only 14 (25%) agreed or strongly agreed that the quality guidelines and resources such as testing kits, and standard operating procedures were sufficiently available at their workplace. Furthermore, 61 (92.4%) agreed or strongly agreed that HPI is significantly associated with different GIT disorders present during childhood and adulthood such as duodenal ulcer, gastric ulcer, dyspepsia, and irritable bowel syndrome. All the respondents expressed their determination to implement evidence-based guidelines when available.

Table 5: Respondents' attitudes on available approaches to HPI

Statement	Strongly agree	Agree	Disagree	Strongly disagree
Sufficient quality guidelines are available for the management of HPI	7 (10.6)	44 (66.7)	14 (21.2)	1 (1.5)
HPI is associated with GIT complications from childhood to adulthood	23 (34.8)	38 (57.6)	5 (7.6)	0 (0)
Sufficient resources and guidelines are available at my workplace for HPI	1 (1.5)	13 (19.7)	42 (63.6)	10 (15.2)
I am determined to implement evidence-based guidelines when available	35 (53)	31 (47)	0 (0)	0 (0)

4.4. Percentage of pediatricians who seek and use guidelines to manage HPI in children

The participants in this study revealed their awareness regarding HPI, their eagerness to seek clinical guidelines, and how they use the clinical guidelines to manage HPI among children in Rwanda, and the responses are presented in table 6. In a pick-all that applies question (allowing to choose more than one option) on the paediatrician's source of medical information, more than two-thirds (78.8%) highlighted medical journals, 56.1% mentioned internet sources, while 19.7% highlighted the NASPGHAN. Other sources of information were conferences (9.1%), newsletters (4.5%), and symposia sponsored or organized by pharmaceutical companies (3.0).

Table 6: Awareness and information seeking

Variables		**N**	**%**
Source of information about HPI	Medical journals	52	78.8
	Conferences	6	9.1
	Newsletters	3	4.5
	Internet	37	56.1
	Pharmaceutical company-sponsored symposia	2	3.0
	NASPGHAN	13	19.7
Awareness on existing journals	Aware and read them often	53	80.3
	Aware but never read them	10	15.2
	Not aware	3	4.5
Awareness on HPI journals	Digestive Health Foundation's HPI information hotline	6	9.1
	American College of Gastroenterology's Practice Guidelines of HPI	29	43.9
	NASPGHAN GERD Guidelines	14	21.2
	ESPGHAN HPI Guidelines	15	22.7
	None	23	34.8
How often do you rely your practice on published guidelines?	Always	43	65.2
	Less often	23	34.8
Paediatricians' preferred publications/ guidelines	American College of Gastroenterology, practice Guidelines of HPI	27	40.9
	Digestive Health Foundation, HPI information hotline	3	4.5
	ESPGHAN HPI Practice Guidelines	10	15.2
	NASPGHAN GERD Guidelines	6	9.1
	None of the above	20	30.3

Regarding respondents' awareness of existing journals, 80.3% responded that they were aware of the journals and read them often, 15.2% responded that, though they were aware of the journals, they never read them and 4.5% revealed they were not aware of the HPI journals at all. The most frequently visited journal by the respondents in this study for HPI guidelines updates was the American College of Gastroenterology's Practice Guidelines on HPI 43.9%, followed by ESPGHAN HPI guidelines (22.7%) and NASPGHAN GERD guidelines (21.2%). The least visited journal was the Digestive Health Foundation's HPI Information Hotline

representing 9.1% of all participants in this study. Only two-thirds (65.2%) of the participants revealed that they always rely on published guidelines to manage HPI while the remaining reported that they less often rely on published guidelines.

4.5. Participants practice the management of HPI

In this study, all participants highlighted treating the HPI with a combination of oral antibiotics and a proton pump inhibitor (PPI). Participants' responses are presented in table 7 and table 8. Even though the choice of antibiotics was different among the participants, the use of amoxicillin remained constant across all responses, and it is combined with either clarithromycin (59.1%) or another antibiotic (40.9%). Other antibiotics mentioned to couple with amoxicillin included metronidazole and levofloxacin. The latter was mentioned also as a second line following the first-line combination with clarithromycin. Furthermore, most participants (56.1%) mentioned prescribing antibiotics for fourteen days while the remaining prescribe the antibiotics either for less than 14 days (minimum reported: 7 days) or more than 14 days (maximum reported: 3 months). Regarding the use of PPI, the participants reported prescribing either omeprazole (30.3%) or esomeprazole (69.7%). Esomeprazole was reported to be prescribed either in its generic name or as a brand name, Nexium tablets, or powder for oral suspension. The participants shared their current practice on how they confirm HPI eradication among affected children and 12.1% reported confirming by using a combination of control tests in addition to a clinical evaluation, while 87.9% reported using only clinical evaluation (6.1%) or control test (81.8%) alone.

Table 7 Reported management of HPI in children

Variable	N	%
Treatment of choice in management		
Amoxicillin + Clarithromycin + PPI	38	57.6
Amoxicillin + Metronidazole + PPI	11	16.7
Amoxicillin + Clarithromycin	1	1.5
Amoxicillin + Metronidazole + Clarithromycin	1	1.5
Clarithromycin + Metronidazole + PPI	0	0
Amoxicillin + Levofloxacin + PPI	0	0
Tri therapy (Not specified)	15	22.7
Prescribed duration of antibiotics		
7 days	2	3.0
7-14 days	2	3.0
10 days	4	6.1
10-14 days	2	3.0
14 days	37	56.1
14-28 days	4	6.1
15 days	1	1.5
21 days	1	1.5
28 days	3	4.5
30 days	7	10.6
4-6 weeks	2	3.0
3 months	1	1.5
How eradication is checked		
Clinical	4	6.1
Stool or Serology test	48	72.7
Clinical and Control test	8	12.1
Endoscopy	2	3
Pathology	1	1.5
UBT	2	3
None	1	1.5

Table 8: Participants' practice toward HPI

Variable		N	%
Choice of amoxicillin combination	Clarithromycin	39	59.1
	Other	27	40.9
Choice of PPI	Omeprazole	20	30.3
	Esomeprazole	46	69.7
ATB duration	14 days	37	56.1
	Other	29	43.9
Confirmation for eradication	Clinical and test	8	12.1
	Either alone	58	87.9

4.6. Factors influencing the HPI diagnostic and management choices of paediatricians in Rwanda.

4.6.1. Utilization of diagnostic tests

The association between the participants' characteristics and the use of investigations to diagnose HPI is presented in table 9. The utilization of investigation tests to diagnose HPI among the paediatric population was almost equal between male and female paediatricians (83.3% vs 94.4%, p=0.241, OR: 3.400, 95%CI: 0.394-29.332). Even though all participants recruited from private health institutions reported the practice of investigating HPI before the initiation of pharmacologic therapy, further statistical tests showed no significant difference relative to the practice in public hospitals (100% vs 85%, p=0.307).

The paediatricians with no additional training beyond the Master of Medicine degree were significantly more likely to practice the request of diagnostic tests relative to other paediatricians with additional training such as Ph.D. or subspecialty training (89.7% vs 62.5%, p=0.036, OR:1.434, 95%CI: 0.833-2.471). Paediatricians with a professional experience of 0 to 5 years were more likely to utilize the investigation tests as compared to others with a more advanced professional experience even though the difference was not statistically significant (91.1% vs 76.2%, p=0.100, OR:0.926-1.545). Similarly, junior consultants did not significantly differ from professionals ranked as consultants or beyond (84.6% vs 87.5%, p=0.739, OR:0.967, 95%CI: 0.791-1.183).

Table 9: Investigation practice for HPI

		Orders investigation for HPI		
		N (%)	**OR (95%CI)**	**p-value**
Gender	Male	40 (83.3)	3.400 (0.394-29.332)	0.241
	Female	17 (94.4)		
Working Place	Public	51 (85.0)	-	0.307
	Private	6 (100.0)		
Additional training	Yes	5 (62.5)	1.434 (0.833-2.471)	**0.036**
	No	52 (89.7)		
Title	Junior consultant	22 (84.6)	0.967 (0.791-1.183)	0.739
	Consultant and beyond	35 (87.5)		
Experience	0-5 years	41 (91.1)	1.196 (0.926-1.545)	0.100
	> 5 years	16 (76.2)		
Reads journals	Yes	45 (84.9)	1.087 (0.896-1.320)	0.486
	No	12 (92.3)		

Table 10 shows the disparities in using different diagnostic tests among our study participants. There was no significant difference between males and females in requesting the endoscopy,

stool antigen, and serology to diagnose HPI. The paediatricians in public health institutions were significantly more likely to use stool antigen as the diagnostic test compared to their counterparts in private institutions (90.0% vs 50.0%, p=0.006, OR:1.800, 95%CI: 0.805-4.024). On the other hand, the paediatricians from private health institutions were significantly more likely to use serology tests to diagnose HPI relative to paediatricians in public institutions (83.3%, vs 40.0%, p=0.041, 95%CI:0.299-0.771). However, there was no significant difference in the utilization of endoscopy to diagnose HPI in public institutions and private institutions even though the former had higher odds (31.7% vs 16.75, p=0.446, OR:1.900, 95%CI: 0.306-11.814).

The choice of a diagnostic test to use to diagnose HPI was statistically similar among all participants irrespective of their professional experience and ranking. However, participants with more than 5 years of professional experience as paediatricians expressed a non-significant higher likelihood of using endoscopy (33.3% vs 28.9%, p=0.714, OR: 1.231, 95%CI: 0.404-3.746) and serology antigen (52.4% vs 40%, p=0.345, OR:0.764, 95%CI: 0.444-1.314) than the less experienced participants. Similarly, participants who were ranked as consultants or beyond did not significantly differ from their counterparts in the use of endoscopy (32.5% vs 26.9%, p=0.630, OR:1.307, 95%CI: 0.439-3.888), stool antigen (90.0% vs 80.8%, p=0.286, OR:2.143, 95%CI: 0.518-8.871), and serology antigen test (47.5% vs 38.5%, p=0.470, OR:1.448, 95%CI: 0.530-3.953) to diagnose HPI.

Table 10 Bivariate analysis of factors associated with the choice of investigation for HPI

		Endoscopy			Stool antigen			Serology		
Factors		**N (%)**	**OR (95%CI)**	**P**	**N (%)**	**OR (95%CI)**	**P**	**N (%)**	**OR (95%CI)**	**P**
Gender	Male	16 (33.3)	1.500	0.382	43 (89.6)	1.152	0.213	23 (47.9)	1.438	0.288
	Female	4 (22.2)	(0.579-3.888)		14 (77.8)	(0.884-1.501)		6 (33.3)	(0.702-2.944)	
Working Place	Public	19 (31.7)	1.900	0.446	54 (90.0)	1.800	**0.006**	24 (40.0)	0.480	**0.041**
	Private	1 (16.7)	(0.306-11.814)		3 (50.0)	(0.805-4.024)		5 (83.3)	(0.299-0.771)	
Additional training	Yes	3 (37.5)	1.447	0.637	7 (87.5)	1.12	0.920	4 (50.0)	1.32	0.713
	No	17 (29.3)	(0.311-6.743)		50 (86.2)	(0.121-10.356)		25 (43.1)	(0.3-5.799)	
Title	Junior consultant	7 (26.9)	1.307	0.630	21 (80.8)	2.143	0.286	10 (38.5)	1.448	0.470
	Consultant and beyond	13 (32.5)	(0.439-3.888)		36 (90.0)	(0.518-8.871)		19 (47.5)	(0.530-3.953)	
Experience	0-5 years	13 (28.9)	1.231	0.714	40 (88.9)	1.098	0.382	18 (40.0)	0.764	0.345
	> 5 years	7 (33.3)	(0.404-3.746)		17 (81.0)	(0.871-1.384)		11 (52.4)	(0.444-1.314)	
Reads journals	Yes	17 (32.1)	1.574	0.527	46 (86.8)	1.195	0.838	24 (45.3)	1.324	0.657
	No	3 (23.1)	(0.383-6.468)		11 (84.6)	(0.217-6.564)		5 (38.5)	(0.383-4.582)	

4.6.2. Treatment for HPI and confirmation for eradication

The participants' choices of antibiotics and duration of pharmacological therapy are displayed in table 11. The combination of amoxicillin and clarithromycin remained the most preferred pharmacological therapy both in public (58.3%) and private (66.7%) health institutions (p=0.692, OR:0.700, 95%CI:0.119-4.123). In addition, only half of the participants from the private institution (50.0%) were prescribing antibiotics for 14 days with no significant difference from public practitioners (56.7%, p=0.754, OR:1.133, 95%CI: 0.494-2.600) and the remaining were either using fewer days or more extended duration of pharmacological therapy.

The junior consultants had a slightly non-significant higher likelihood of preferring Clarithromycin as the best choice to combine with amoxicillin relative to consultants and beyond (61.5% vs 57.5%, p=0.744, OR: 0.905, 95%CI: 0.494-1.658), but the latter were significantly more likely to prescribe the antibiotics for 14 days (73.1% vs 45.0%, p=0.025, OR:1.624, 95%CI: 1.073-2.458). One-third (33.3%) of the participants with a professional experience of more than 5 years preferred an antibiotic other than clarithromycin to combine with Amoxicillin as it was found in 44.4% of the participants with an experience of 0 to 5 years (p=0.392, OR:1.333, 95CI: 0.67-2.651). Also, only less than two-thirds (62.2%) of participants with 0 to 5 years of experience were prescribing antibiotics for 14 days which was statistically comparable to only 42.9% of the participants with more than 5 years of professional experience (p=0.140, OR:0.455, 95CI: 0.159-1.306).

As displayed in table 12 representing the participants' practice on confirmation of eradication, 23.8% of the participants with more than 5 years of experience were significantly more likely to use both a clinical evaluation and a control test compared to only 6.7% of their counterparts with less experience (p=0.047, OR:1.225, 95%CI: 0.953-1.575). While 33.3% of participants from private health institutions confirm the eradication based on both clinical progress and control test, 90.0% of participants from public institutions use the clinical evaluation alone or a control test alone (p=0.095, OR:1.350, 95%CI: 0.762-2.392).

Table 11: Bivariate analysis of factors associated with antibiotic management of HPI

		Choice of amoxicillin combination, N (%)				ATB Duration, N (%)			
		Clarithromycin	**Other**	**OR (95% CI)**	**P**	**14 days**	**Other**	**OR (95% CI)**	**p**
Gender	Male	29 (60.4)	19 (39.6)	0.891	0.721	26 (54.2)	22 (45.8)	1.330	0.613
	Female	10 (55.6)	8 (44.4)	(0.477-1.662)		11 (61.1)	7 (38.9)	(0.441-4.013)	
Working Place	Public	35 (58.3)	25 (41.7)	0.700	0.692	34 (56.7)	26 (43.3)	1.133	0.754
	Private	4 (66.7)	2 (33.3)	(0.119-4.123)		3 (50.0)	3 (50.0)	(0.494-2.600)	
Additional training	Yes	6 (75.0)	2 (25.0)	0.440	0.329	4 (50.0)	4 (50.0)	0.758	0.713
	No	33 (56.9)	25 (43.1)	(0.082-2.367)		33 (56.9)	25 (43.1)	(0.172-3.328)	
Title	Junior consultant	16 (61.5)	10 (38.5)	0.905	0.744	19 (73.1)	7 (26.9)	1.624	**0.025**
	Consultant and beyond	23 (57.5)	17 (42.5)	(0.494-1.658)		18 (45.0)	22 (55.0)	(1.073-2.458)	
Experience	0-5 years	25 (55.6)	20 (44.4)	1.333	0.392	28 (62.2)	17 (37.8)	0.455	0.140
	> 5 years	14 (66.7)	7 (33.3)	(0.67-2.651)		9 (42.9)	12 (57.1)	(0.159-1.306)	
Reads journals	Yes	33 (62.3)	20 (37.7)	0.519	0.290	31 (58.5)	22 (41.5)	1.644	0.422
	No	6 (46.2)	7 (53.8)	(0.153-1.766)		6 (46.2)	7 (53.8)	(0.486-5.566)	

Table 12: Duration of antibiotics

		Confirmation for eradication, N (%)			
		Clinical and test	**Either alone**	**OR (95%CI)**	**p-value**
Gender	Male	6 (12.5)	42 (87.5)	1.143 (0.209-6.261)	0.878
	Female	2 (11.1)	16 (88.9)		
Working Place	Public	6 (10.0)	54 (90.0)	1.350 (0.762-2.392)	0.095
	Private	2 (33.3)	4 (66.7)		
Additional training	Yes	0 (0.0)	8 (100)	0.862 (0.778-0.956)	0.262
	No	8 (13.8)	50 (86.2)		
Title	Junior consultant	1 (3.8)	25 (96.2)	1.166 (0.991-1.371)	0.097
	Consultant and beyond	7 (17.5)	33 (82.5)		
Experience	0-5 years	3 (6.7)	42 (93.3)	1.225 (0.953-1.575)	**0.047**
	> 5 years	5 (23.8)	16 (76.2)		
Reads journals	Yes	7 (13.2)	46 (86.8)	0.548 (0.061-4.891)	0.585
	No	1 (7.7)	12 (92.3)		

CHAPTER V. DISCUSSION

This study aimed at exploring the awareness of Rwandan paediatricians regarding HPI management evidence, their attitudes, and their practices regarding the management of HPI among the paediatric population. The paediatricians in this study have demonstrated awareness of the informative sources of evidence related to HPI diagnosis and treatment among children with more than 95% expressing continuous medical education by accessing medical journals on HPI. The study shows that the management of HPI among Rwandan paediatric patients consists of the standard tri-therapy combination of two antibiotics and a PPI but showed inconsistency in the prescribed duration of antibiotics both in private and public health services but also highlighted the lack of guidelines and standard operative procedures at the workplace and an open determination of paediatricians to implement the guidelines when they would be available. These results reflect an exciting paediatric care preparedness to treat children based on the available evidence, especially in a country where limited randomized trials are available, and hence, learning from other recognized sources of information fills the gap while also attaining international standards.

The Rwandan paediatricians in this study have demonstrated the main source of information such as medical journals (78.8%) as the paediatricians in the United States of America (USA), among whom, 81% mentioned the medical journals during an internet-based survey among NASPAGHAN members (14). However, the study in the USA showed higher rates of paediatricians getting information from conferences (17%) relative to the results from our study (9.1%). Furthermore, nearly two-thirds of the participants in this study reported relying their practice on published guidelines and this is higher in relation to the results from Israeli where only 50% of primary care paediatricians reported using professional guidelines in the management of HPI(44).

The results from this study highlight that only 39% of Rwanda paediatricians explore the testing for HPI for children before attaining the fifth birthday, including only 3% who test for the infection among children in their first year of life. Even though HPI has been long believed to start manifestations during early adulthood or even later in adulthood, more recent studies have demonstrated the infection to be prevalent among children from as early as 4 months (43% of children) in Iran, with a cumulative increase in prevalence as the children age (45), and case reports of rare presentation among newborns (46). A study in Iran has also shown that by age of 2 years, two-thirds of children have already the HPI. Additionally, prior studies in Uganda, a neighboring country of Rwanda, have found a prevalence of 33.3% of HPI among

children aged less than 6 months (47). This indicates a missed opportunity to timely diagnose HPI among under-five children which further may lead to persistently untreated infection. The persistently untreated HPI among children aged five to seven years is documented to be significantly associated with lower growth in height and weight than non-infected children in Germany, especially among male children (48). Whether this has a relationship with the reported high prevalence of stunting among Rwandan children has not been investigated (37.0% among males and 29.2% among females)(49). However, the lack of evidence-based guidelines in the workplace reported by 75% of paediatricians in this study would be a hindering factor towards good practice. To express the need for action, our results have also shed light on the paediatricians' strong determination to implement evidence-based practice, would the guidelines be available in their workplace.

While endoscopy is considered the recommended diagnostic test for H pylori among children (50), it was utilized by only 31.3% of paediatricians in this study. It is important to note that, in Rwandan public health institutions, endoscopic evaluation is available at only four referral hospitals, of which, three are in the capital city of the country. In addition to that, the public health insurance in the country does not allow non-emergency patients to go directly to referral hospitals(51) unless they are accepting to afford the totality of the medical bill, which would be expensive to the majority of Rwandans. The low use of endoscopic exams is further supported by the resulting availability of endoscopy for only 15% of paediatricians in this study. Therefore, it is not surprising that over 90% of paediatricians in this study are widely using other supportive non-invasive tests such as stool antigen and serology antigen tests to diagnose HPI in children (50,52). However, this is contrary to the standard "guidelines for the management of helicobacter pylori in children and adolescents" that do not recommend the use of either serology or non-invasive tests for the initial diagnosis of HPI except in special cases such as children with immune thrombocytopenic purpura or first-degree family history of gastric cancer (42,50). This wide utilization of antigen detection as the primary diagnostic approach for HPI was similar to the results from Ethiopia, and Latvia (53,54). Similarly, over 81% of primary care pediatricians in the USA, also reported using serology antigens as the primary HPI diagnostic test (14). The availability of endoscopic exams at the workplace reported by only 15% but utilized by 31.3% indicates a well-functioning inter-facility collaboration where patients who are evaluated in settings that do not own an endoscopic technology are referred to undergo the exam to other settings where it is available.

Although there exists no recommendation for systematic testing or screening for HPI among children, there are documented indications that should alert paediatricians to rule out the possibility of HPI, which includes anemia, a common finding in one-third of Rwandan children aged under five (55).

The results from our study show that the pharmacologic choices to treat HPI in children in Rwanda are in accordance with the "Joint ESPGHAN/NASPGHAN Guidelines for the Management of HPI in Children and Adolescents" updated in 2016, suggesting the use of a PPI with amoxicillin and clarithromycin or metronidazole(42). However, while these joint guidelines recommend a treatment period of 14 days, only 56% of our respondents were practicing adherence to the recommended 14 days, with the remainder prescribing the antibiotics for either a shorter or a longer duration. Due to the critical importance of prescribing the correct medications, for the correct frequency and duration of administration for the successful eradication of HPI(56), it is likely that many Rwandan children with HPI may have failed to eradicate the infection due to incorrect exposure to antibiotherapy. This wide variability in the prescription duration of antibiotics against HPI can also be a result of the lack of guidelines at the workplace as reported by most paediatricians in this study and hence the practice lacks standardization.

The observed higher likelihood of correct antibiotics prescription among junior paediatricians may reflect the knowledge retention from their academic training while the more experienced paediatricians might be prescribing the medication based on their experience of what works best for their clients, which is often not necessarily based on tested evidence. To further support their reliance on their clinical experience, paediatricians with more than 5 years of experience were found to be more likely to combine the control test for HPI with the clinical response of the patients to confirm the HPI eradication, as opposed to the less experienced practitioners who were more likely to utilize either the test or the clinical evolution alone.

Conclusions and Recommendations

Rwandan paediatricians are aware of the current evidence regarding the management of helicobacter infection and most of them are not only willing to improve their practice based on tested and published evidence but have taken a step further for their own continuous medical education. Even though there are abundant guidelines regarding the management of HPI, these guidelines have not been institutionalized to meet the context of Rwandan health settings, hence the lack of treatment guidelines at many workplaces. This led to differences in clinical practices depending on the paediatrician's experience, among other factors, as revealed by this study. Like in many other places around the globe, the paediatricians in Rwanda commonly offer HPI testing for eligible children during early childhood and are well adherent to the correct choice of pharmacologic therapy even though consistency in utilizing the recommended duration of antibiotics was not observed. The lack of significant differences between private and public health institutions represented in this study is a mirror of the homogeneity of the challenges met in both sectors, but it is important to note that most paediatricians in Rwanda are enrolled in dual clinical practice in both public and private health sectors.

Recommendations to the Ministry of Health

- To approve and endorse newly developed guidelines for diagnosing and managing paediatric HPI in Rwanda.
- We recommend the development of a paediatric gastroenterology training program. This would fill the gap that currently exists in Rwanda as there are no pediatric gastroenterologists.
- To avail diagnostic modalities and organize community-oriented health education on HPI to maximize the utilization of the available paediatric healthcare services in the country.

Recommendations to the Rwanda Paediatric Association

- To institutionalize the already existing evidence on HPI among the paediatric population and a need to promote continuous medical education for capacity building of the paediatricians.
- Continuous medical education should include education on evidence-based guidelines for the management of HPI. We recommend this training be delivered at all teaching and district hospitals for maximum uptake.

• Paediatricians are encouraged to enhance health education for patients on preventive measures to decrease the rate of reinfection. Patient education should target those with a history of HPI, their families and close community, and those with known risk factors (more than 5 children in the house, low socioeconomic status). The content of this education should include disease prevention behaviors, such as handwashing prior to breastfeeding, early consultation, adherence to treatment, and sanitary conditions for food preparation. Education should be delivered at the hospital and community level(57). Where possible, hospitals should create and sustain the inter-facility agreement to utilize the existing minimum capacity, with the aim to serve the maximum number of patients as stated by the Sustainable Development Goals (SDG) seventeen on "Partnerships to achieve the goal". In the future, we recommend the use of this tool in a separate population of paediatric providers to assess the validity of the questionnaire.

Strengths and limitations of the Study

The prospective nature of this study allowed the recruitment of real-time information from the study participants. Other strengths rely on the recruitment of paediatricians in clinical practice and experience in the subject matter from all the country's rural and urban health districts. The self-administered questionnaire also allowed the participants to freely respond to the study questions which facilitated the analysis of their lived experiences.

However, the low number of paediatricians in the country was a limitation to generate a more powerful sample size that would have stimulated a logistic regression model for analysis. Responses may have social desirability bias as paediatricians were likely to want to be seen favorably.

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APPENDIX

Appendix 1. Consent form.

Project title: "Awareness, attitude, and practice of pediatricians in relation to Helicobacter pylori infection (HPI) diagnosis and management in Rwanda.

This Informed Consent Form has two parts:

- Information Sheet (to share information about the research with you)
- Certificate of Consent (for signatures if you agree to take part)

PART I: Information Sheet

We are Dr. Emmanuel Nubahumpatse, the Principal Investigator, and Dr. Jean Claude Kabayiza, Dr. Cliff O' Callahan, Dr. Christian Umuhoza, and Dr. Maurice Nsanzabera supervisors of this research study titled Awareness, attitude, and practice of paediatricians in relation of Helicobacter pylori infection (HPI) diagnosis and management in Rwanda.

We are inviting you to participate in this study by filling out the questionnaire provided together with this consent form. Your participation in this study will help us to evaluate awareness, attitudes, and practices in relation to helicobacter pylori infection in Rwanda.

The purpose of this study is to evaluate the awareness, attitude, and practice of paediatricians in relation to Helicobacter pylori infection (HPI) diagnosis and management in Rwanda

We value your feedback. We value your experience. Therefore, we kindly request you to participate in this research study by providing responses that will be used to meet the aims and study objectives.

The proposed study will comply with the ethical principles of research. This study has already obtained approval and clearance from the Institutional Review Board (IRB) of the College of Medicine and Health Sciences (CMHS) at the University of Rwanda (UR) and the ethical committee of the University Teaching Hospital of Kigali (CHUK). Extreme care will be taken to ensure that the study is done in an ethical manner giving top priority to the respondents' rights.

The principal investigator is a post-graduate in pediatrics and this research study is his dissertation and is part of the academic requirements to complete the training. The responses you provide will be kept confidential. Your participation is entirely voluntary and anonymous. You will not have to provide your identifiers on the questionnaire.

In case you accept to participate, please take 10 minutes to complete this survey questionnaire.

You do not have to take part in this research if you do not wish to do so. You may also stop participating in this research at any time you want to. It is your choice, and all your rights will still be respected.

Contacts and Questions:

You may ask any questions you have now. Or if you have questions later, you may contact the researcher via phone: at +250 783 353 935, or email: nub.emmy@gmail.com. If you want to talk privately about your rights as a participant, you contact the University of Rwanda Institution Review Board via the telephone numbers of the Chairperson of the CMHS IRB (+250 788 490 522) or the Ethical Committee at CHUK via the telephone number of chairperson (+250 787 553 420)

- The researcher will give you a copy of this form to keep. (For face-to-face research)
- Please print or save this consent form for your records. (For online research)

PART II: Certificate of Consent

"I have read the foregoing information, or it has been read to me. I have had the opportunity to ask questions about it and any questions that I have asked to have been answered to my satisfaction. I consent voluntarily to participate as a participant in this research."

Participant Names and Signature……

Date …….

Appendix 2. Study questionnaire

SECTION ONE: SOCIO-DEMOGRAPHIC CHARACTERISTICS OF PARTICIPANTS

Q1. Select your sex

a. Female
b. Male

Q2. Please choose the type of health facility you are working in.

a) Public
b) Private

If your answer is **A** on **Q2**, then go to **Q3**, and if your answer is **B**, then go to **Q4**

Q3. How much time in percentage do you work in public health facilities?

a. 0-25%
b. 25-50%
c. 50-75%
d. 75-100%

Q4. How much time in percentage do you work in a private health facility?

a. 0-25%
b. 25-50%
c. 50-75%
d. 75-100%

Q5. Do you work in both public and private health facilities?

a) Yes
b) No

Q6. If **yes**, how much time in percentage do you work in both public and private respectively?

a. 50% verse 50%
b. 75% verse 25%
c. 25% verse 75%
d. None of the above, specify …….

Q7. What is your highest education level attained?

a) MD, MMED
b) MD, MMED PhD

c) Other: specify…….

Q8. What is your title in practice?

a) Junior paediatrician
b) Senior consultant paediatrician
c) Chief consultant paediatrician
d) GI specialist (paediatrics)
e) Other. Specify…….

Q9. For how many years have you been practicing as a paediatrician?

a. 0-5 years
b. 5-10 years
c. 10-15Years
d. 15-20 years
e. 20 years and above

SECTION 2: QUESTIONS ON PEDIATRICIANS'AWERENESS OF HPI

Q10. Do you order diagnostic testing for Helicobacter pylori (HPI) in your routine practice?

a) Yes
b) No

Q11. If yes, which one of the tests listed below do you order? (Mark all that
Apply in the preference they are ordered)

a) Upper GI endoscopy (with biopsy)
b) Stool antigen
c) Urea Breath test (UBT)
d) Serology (ELISA, PCR)
e) Others, specify…….

Q12. At what earliest patient age do you start testing and treating HPI (select one appropriate answer)

a) Preterm and term neonates
b) Older than 1 month
c) Older than 1 year
d) Older than 5 years
e) 6–12 years
f) >12 years

Q13. Based on your clinical experience, what is the percentage of children <5 y old who have new onset of HPI symptoms become adolescents or adults with complications of HPI

a) 0%–10%
b) 11%–25%
c) 26%–50%
d) 51%–75%
e) >76%
f) No idea

Q14. What are your sources of HPI-related information? (Select top 3)

a) Medical journals
b) Conferences
c) Newsletters
d) Internet
e) Pharmaceutical company-sponsored symposia
f) NASPGHAN

Q15. Are you aware of some publications and do you read them?

a) Aware and read them often
b) Aware of them but never read them
c) Not aware

Q16. Please select the publications, of which you are aware (Select all that apply)

a) Digestive Health Foundation's HPI information hotline
b) American College of Gastroenterology's Practice Guidelines of HPI
c) NASPGHAN GERD Guidelines
d) ESPGHAN HPI Practice Guidelines
e) None of the above

SECTION 3: QUESTIONS ON PAEDIATRICIANS' ATTITUDE REGARDING HPI MANAGEMENT

Please tell us your thought about the following statements on a Likert scale.

Q17. The quality and quantity available in different publications and guidelines about HPI are sufficient for us paediatricians to make evidence-based decisions in the diagnosis and management of HPI.

a) Strongly agree
b) Agree

c) Disagree
d) Strongly disagree

Q18. H. pylori is significantly associated with different GIT disorders, which present during childhood and adulthood such as Duodenal ulcer, Gastric ulcer, Gastric cancer, Dyspepsia, and IBS (irritable bowel syndrome)

a) Strongly agree
b) Agree
c) Disagree
d) Strongly disagree

Q19. Available resources at health facilities where I work such as testing kits, standard operating procedures (SOPs) and printed guidelines are sufficient for me to diagnose and manage HPI in children confidently.

a) Strongly agree
b) Agree
c) Disagree
d) Strongly disagree

Q20. Basing our practice on published guidelines would minimize diagnosis errors and promote treatment and eradication of HPI

a) Strongly agree
b) Agree
c) Disagree
d) Strongly disagree

Q21. I am determined and willing to relay my practice regarding HPI diagnosis and management on updated guidelines if available.

a) Strongly agree
b) Agree
c) Disagree
d) Strongly disagree

SECTION 4: QUESTIONS ON PEDIATRICIANS'PRACTICE REGARDING HPI

Q22. How often do you rely on your practice on published guidelines?

a) Always
b) Less often
c) Never at all

Q23. Which of the following publications/ guidelines do you base your practice on?

a) Digestive Health Foundation's HPI information hotline
b) American College of Gastroenterology's Practice Guidelines of HPI
c) NASPGHAN GERD Guidelines
d) ESPGHAN HPI Practice Guidelines
e) None of the above

Q24. Which one of the following tests considered as most effective and reliable in the diagnosis of H-pylori infection in children in your practice?

a) Serologic test
b) Stool Ag test
c) UBT test effective
d) Endoscopy

Q25. Would you please tell us your treatment of choice in the management of HPI in children?

……
……

Q26. For how long do you treat HPI to ensure that it is cured and eradicated?

……
…….

Q27. what do you do to be sure that HPI has been eradicated after treatment completion?

……
……