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# Factors, beliefs, and barriers associated with adherence to secondary prophylaxis amongst children and adolescents with rheumatic heart disease at public tertiary hospitals in Rwanda: A cross-sectional observational study

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## ABSTRACT

**INTRODUCTION:** Rheumatic heart disease (RHD) is the most prevalent cardiovascular disease among young people under 25 years. This study aimed to explore the factors, beliefs, and barriers associated with adherence to penicillin among children and adolescents with RHD undergoing secondary prophylaxis at public tertiary hospitals in Rwanda.
**METHODS:** This cross-sectional observational study included children aged 5 to 18 years diagnosed with RHD and on secondary prophylaxis for at least six months, from two public tertiary hospitals in Rwanda. Regression analyses were performed to identify factors associated with adherence.
**RESULTS:** Employment status was significantly associated with adherence to prophylaxis (OR [95% CI]: 12.17 [1.42-103.9], p=0.022). Living in an urban area also increased the likelihood of adherence compared to rural areas (OR [95% CI]: 9.05 [2.28-35.91], p=0.001). A long distance to the clinic was strongly associated with poor adherence (OR [95% CI]: 5.55 [1.94-15.89], p=0.001). Additionally, long waiting times at the clinic are also significantly associated with poor adherence (OR [95% CI]: 4.77 [1.69-13.43], p=0.003). Patients with good adherence have significantly higher belief scores than those with poor adherence (M ± SE: 1.56 ± 0.54, t=2.878, p=0.005), and patients with higher barrier scores are significantly less adherent than those with lower barrier scores (M ± SE: 4.6 ± 0.85, t=5.531, p<0.001).
**CONCLUSION:** Factors negatively affecting adherence included parental unemployment and rural residence. Long travel distances and extended waiting times at clinics were the most common barriers to adherence. To improve adherence, educational efforts targeting RHD patients and their caregivers should be strengthened, and RHD prevention activities should be decentralized to health centers.

## INTRODUCTION

Rheumatic Heart Disease (RHD) is the most common acquired cardiovascular disease in young people aged <25 years [1]. Acute Rheumatic Fever (ARF) and RHD are the leading causes of cardiac mortality among children and young people in developing countries [2]. ARF mainly affects the joints, skin, heart, and central nervous system, and cardiac involvement leads to permanent valve

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damage. It commonly occurs between the ages of 4-15 years and takes place 2-3 weeks after GAS upper respiratory tract infection. Although ARF has almost disappeared in the developed world due to improved sanitation and socioeconomic conditions, it continues to be a serious public health problem in developing countries [3]. In Rwanda, RHD is a significant health problem, with an estimated prevalence of 6.8 per 1000 schoolchildren [4].

Prevention of ARF includes primordial prevention, which involves improving socioeconomic conditions; primary prevention, which involves prompt treatment of GAS pharyngitis; and secondary prevention, which involves a continuous administration of benzathine penicillin G to patients with a previous attack of ARF or well-documented RHD [5]. Another intervention in the prevention of early mortality due to RHD is cardiac surgery, which is not accessible to many patients, especially in low-income countries [6]. Even after heart surgery, patients are exposed to many complications, such as thrombo-embolic events and severe bleeding, when using warfarin treatment [7]. The cost-effective strategy remains the prevention of ARF and progression to severe rheumatic valvular heart disease [8].

Although based on a low level of evidence, intramuscular penicillin was shown to be more effective than oral penicillin [9]. The rate of adherence to secondary prophylaxis is unknown in many countries of sub-Saharan Africa, particularly in Rwanda. Different factors associated with adherence have been reported in various regions of the world. These include socioeconomic status, knowledge about the disease, waiting time at the clinic, the painful aspect of the injections, and distance to the clinic [1,10].

Knowing different factors, beliefs, and barriers associated with adherence would help clinicians find ways of improving adherence to secondary prophylaxis and thus improve the quality of life of our patients. This research project aimed to explore factors, beliefs, and barriers associated with adherence to injectable forms of penicillin in children and adolescents with RHD receiving secondary prophylaxis at public tertiary hospitals in Rwanda.

## METHOS

**Study design and settings:** This was a cross-sectional observational study involving children and adolescents with RHD presenting to the outpatient or inpatient pediatric departments at two public tertiary hospitals in Rwanda [Kigali University Teaching Hospital (CHUK) and Butare University Teaching Hospital (CHUB)]. Data collection was conducted over five months, from January to May 2019. The study focused on children aged 5 to 18 years who had been diagnosed with RHD and had been receiving secondary prophylaxis for at least six months. In Rwanda, the pediatric age range is defined as 0 to 15 years. Patients aged 15 years and older are typically treated in internal medicine. However, those aged 15 to 18 years continue to receive follow-up care in the pediatric department following cardiac surgery.

**Study population:** The study included patients aged 5-18 years with confirmed RHD by echocardiography, treated at the CHUK and CHUB OPD pediatric cardiology, who consent to participate, receive monthly intramuscular penicillin injections, and consult two tertiary level hospitals. Exclusion criteria include patients/guardians who decline to sign consent forms, patients on secondary prophylaxis for less than 6 months, and patients on oral penicillin for prophylaxis.

**Sample size calculation:** A sample size calculation has been calculated using the Raosoft formula as follows:

$$X=Z(c/100)^2r(100-r)$$
$$N=N\ x/((N-1)E^2 + x)$$
$$E=Sqrt[(N - n)x/n(N-1)]$$

Where:

**E** is the margin of error and is of about 5%

**N** is the population size. In this case, it is 80, the total number of patients received in pediatric outpatient in a period of 4 months

**r** is the fraction of response we are interested in, in this case, 54%, based on a study done in Uganda [10].

**Z(c/100)** is the critical value for the confidence level c, 95% confidence interval.

n is the minimum sample size and is equal to 67

**Sampling**: All participants fulfilling inclusion criteria were included and sampled by convenience sampling technique

**Data Collection Tool**: We used a modified questionnaire originally developed by Balbaa et al. [1] in Egypt in 2015. A certified translator translated the questionnaire into Kinyarwanda and then back-translated it by a medical professional to ensure accuracy. The principal investigator collected data, entered it into Epidata version 3.1, and coded it for analysis.

**Data Analysis**: Data from Epidata were exported to IBM SPSS version 25 for analysis. For descriptive analysis, continuous variables were summarized using means and medians, while categorical data were summarized with frequencies and percentages. To analyze factors associated with adherence, bivariate analysis was performed using logistic regression to calculate odds ratios (ORs). Multivariate analysis was then conducted to control for confounding factors and to identify independent variables associated with poor compliance. Variables with a p-value <0.05 from the bivariate analysis were included in the multivariate model. The final multivariate analysis results were reported using ORs and p-values. Comparisons of Likert-scale responses were also made to evaluate differences in scores between participants with good and poor adherence.

**Ethical Considerations**: Permission to conduct this study was obtained from the Institutional Review Board of the College of Medicine and Health Sciences (CMHS), University of Rwanda (CMHS IRB approval notice number: 377/CMHS IRB/2018). Additional approvals were received from the CHUK Research Ethical Committee (CHUK research committee: Ref-EC/CHUK/736/2018) and from CHUB Research ethical committee (CHUB: RC/UTHB/051/2018). Participants provided written consent, and their participation was entirely voluntary.

## RESULTS

### Socio-Demographic Characteristics of the Study Population

A total of 67 participants meeting the inclusion criteria were interviewed. The median age was 13.3 ± 3 years (IQR 11-16), with 64.2% (N=43) being female. The majority of participants (82.1%, N=55) were recruited from CHUK, while the remaining were from CHUB. Most participants (74.6%, N=50) reside in rural areas, and a large proportion (64.1%, N=43) come from economically disadvantaged backgrounds, belonging to Ubudehe categories 1 and 2. Additionally, 46.3% (N=31) of guardians or caretakers completed only primary education, and only 13.4% (N=9) of parents or guardians hold formal employment.

**Table 1:** *Socio-demographic characteristics*

| Characteristics | N | % |
|---|---|---|
| Age (Mean ± SD) | 13.3 ± 2.7 years | |
| **Gender** | | |
| Female | 43 | 64.2 |
| Male | 24 | 35.8 |
| **Place of recruitment** | | |
| CHUK | 55 | 82.1 |
| CHUB | 12 | 17.9 |
| **Economic class (Ubudehe)** | | |
| Category 1 | 7 | 10.4 |
| Category 2 | 36 | 53.7 |
| Category 3 | 24 | 35.8 |
| **Time since diagnosis was made** | | |
| 0-5 years ago | 50 | 74.6 |
| >5 years | 17 | 25.4 |
| **Employment status of caretaker** | | |
| Employed | 9 | 13.4 |
| Unemployed | 58 | 86.6 |
| Address | | |
| Urban | 17 | 25.4 |
| Rural | 50 | 74.6 |
| **Recruitment setting** | | |
| OPD | 65 | 97.0 |
| Inpatient | 2 | 3.0 |
| **Level of education of participant** | | |
| Primary completed | 39 | 58.2 |
| None | 28 | 41.8 |
| **Level of education of parent/caretaker** | | |
| University completed | 1 | 1.5 |
| High school completed | 9 | 13.4 |
| Vocational completed | 11 | 16.4 |
| Primary completed | 31 | 46.3 |
| None | 15 | 22.4 |

*SD: Standard deviation; OPD: Outpatient department*

**Table 2:** *Patient Practices, Beliefs, and Awareness Regarding Prophylaxis and Management of Rheumatic Heart Disease*

| | N | % |
|---|---|---|
| **Missed injections in last 6 months** | | |
| No | 30 | 44.8 |
| Yes | 37 | 55.2 |
| **Period of starting prophylaxis** | | |
| Less than 1 year | 8 | 11.9 |
| 1-2 years | 20 | 29.9 |
| 2-5 years | 24 | 35.8 |
| >5 years | 15 | 22.4 |
| **Action taken when missed appointment** | | |
| I wait till next appointment | 22 | 32.8 |
| I go a few days later | 45 | 67.2 |
| **Awareness of side effects** | | |
| No | 40 | 59.7 |
| Yes | 27 | 40.3 |
| **If no injections** | | |
| May heart condition will get worse | 51 | 76.1 |
| It's ok to miss some doses, nothing will happen | 16 | 23.9 |
| **Awareness for need of surgery** | | |
| No | 11 | 16.4 |
| Yes | 56 | 83.6 |
| **Waiting time at the clinic** | | |
| 20-40 min | 5 | 7.5 |
| 40-60 min | 28 | 41.8 |
| 1-2 hours | 29 | 43.3 |
| >2 hours | 5 | 7.5 |
| **Awareness on the stop of progression by the injections** | | |
| No | 8 | 11.9 |
| Yes | 59 | 88.1 |
| **Belief on effectiveness of traditional medication** | | |
| No | 64 | 95.5 |
| Yes | 3 | 4.5 |
| **Hospitalized due to this condition** | | |
| No | 7 | 10.4 |
| Yes | 60 | 89.6 |
| **Ever had severe side effects from injections** | | |
| No | 65 | 97.0 |
| Yes | 2 | 3.0 |
| **Time from home to the clinic** | | |
| 1 hour | 27 | 40.3 |
| 1-3 hours | 35 | 52.2 |
| 3-5 hours | 4 | 6.0 |
| >5 hours | 1 | 1.5 |

**Patient Practices, Beliefs, and Awareness Regarding Rheumatic Heart Disease Management**

The study revealed that 55.2% of participants missed at least one scheduled injection in the past six months, with 67.2% attending a few days later and 32.8% waiting until the next appointment. Awareness of side effects was low (59.7%), though severe side effects were rare (3.0%). Most participants (76.1%) believed missing injections would worsen their heart condition, and 88.1% trusted penicillin injections to halt disease progression. Awareness of the need for surgery was high (83.6%), and nearly all participants (95.5%) distrusted traditional medicines. Long waiting times (41.8%-43.3% waited 40 minutes to 2 hours) and travel distances (52.2% traveled 1-3 hours) were noted challenges. Additionally, 89.6% had been hospitalized, highlighting the disease's severity (Table 2).

**Socioeconomic factors associated with adherence**

Table 3 presents the socioeconomic factors associated with adherence to RHD secondary prophylaxis. There is a strong association between the employment status of the parent or guardian and adherence, with participants who have an employed parent or guardian showing significantly better adherence (OR [95% CI]: 12.17 [1.42-103.9], p=0.022). Additionally, living in an urban area is associated with higher adherence to RHD secondary prophylaxis compared to residing in a rural area (OR [95% CI]: 9.05 [2.28-35.91], p=0.001). The table also indicates that a higher educational level of the parent or guardian is positively associated with adherence (OR [95% CI]: 3.4 [1.15-10.12], p=0.027).

**Barriers, beliefs, and behaviors associated with adherence**

Table 4 highlights various barriers, beliefs, and behaviors linked to adherence to secondary prophylaxis. A long distance to the clinic is strongly associated with poor adherence (OR [95% CI]: 5.55 [1.94-15.89], p=0.001). Additionally, long waiting times at the clinic are also significantly associated with poor adherence (OR [95% CI]: 4.77 [1.69-13.43], p=0.003).

**Table 3:** *Socioeconomic factors associated with adherence to RHD secondary prophylaxis*

| Socio-economic variables | Self-reported adherence | | OR (95% CI) | P value |
|---|---|---|---|---|
| | Adherent | Non-adherent | | |
| **Gender** | | | | |
| Female | 20 (46.5%) | 23 (53.5%) | 1.02 (0.37-2.79) | 0.957 |
| Male | 11 (45.8%) | 13 (54.2%) | | |
| **Home address** | | | | |
| Urban | 14 (82.4%) | 3 (17.6%) | 9.05 (2.28-35.91) | 0.001 |
| Rural | 17 (34.0%) | 33 (66.0%) | | |
| **Employment status of parent/guardian** | | | | |
| Employed | 8 (88.9%) | 1 (11.1%) | 12.17 (1.42-103.9) | 0.022 |
| Unemployed | 23 (39.7%) | 35 (60.3%) | | |
| **Who accompanies the patient to the clinic?** | | | | |
| None | 5 (26.3%) | 14 (73.7%) | | |
| Family member | 26 (54.2%) | 22 (45.8%) | 3.31 (1.02-10.64) | 0.044 |
| **Level of education of parent/guardian** | | | | |
| Secondary/University | 14 (66.7%) | 7 (33.3%) | 3.4 (1.15-10.12) | 0.027 |
| Primary/None | 17 (37.0%) | 29 (63.0%) | | |
| **Economic class (Ubudehe)** | | | | |
| Category 1 & 2 | 16 (37.2%) | 27 (62.8%) | | |
| Category 3 | 15 (62.5%) | 9 (37.5%) | 2.81 (1.0-7.89) | 0.049 |

**Table 4:** *Barriers, beliefs, and behaviors associated with adherence*

| Barriers, beliefs, and behaviors | Self-reported adherence | | OR (95% CI) | P value |
|---|---|---|---|---|
| | Adherent | Non-adherent | | |
| **Long distance to the clinic** | | | | |
| Yes | 9 (26.5%) | 25 (73.5%) | | |
| No | 22 (66.7%) | 11 (33.3%) | 5.55 (1.94-15.89) | 0.001 |
| **Long waiting time at the clinic** | | | | |
| Yes | 10 (28.6%) | 25 (71.4%) | | |
| No | 21 (65.6%) | 11 (34.4%) | 4.77 (1.69-13.43) | 0.003 |
| **Awareness of side effects of the injections** | | | | |
| Yes | 17 (42.5%) | 23 (57.5%) | 0.68 (0.25-1.83) | 0.452 |
| No | 14 (51.9%) | 13 (48.1%) | | |
| **Consequences of not getting the injections** | | | | |
| Worsening my heart condition | 27 (52.9%) | 24 (47.1%) | 3.37 (0.95-11.87) | 0.058 |
| It's ok, nothing will happen | 4 (25.0%) | 12 (75.0%) | | |
| **Awareness of possible surgery** | | | | |
| Yes | 24 (42.9%) | 32 (57.1%) | 0.43 (0.11-1.63) | 0.214 |
| No | 7 (63.6%) | 4 (36.4%) | | |
| **Knowledge of the role of secondary prophylaxis** | | | | |
| Yes | 26 (44.1%) | 33 (55.9%) | 0.63 (0.15-2.58) | 0.521 |
| No | 5 (62.5%) | 3 (37.5%) | | |
| **Belief in traditional healers** | | | | |
| Yes | 3 (100%) | 0 (0.0%) | 8.96 (0.44-180.7) | 0.152 |
| No | 28 (43.8%) | 36 (56.3%) | | |

*OR: Odd ratio; CI: Confidence Interval*

### Relationship between barriers and beliefs with adherence

Table 5 compares adherent and non-adherent patients based on their beliefs and barriers. It shows that patients with good adherence have significantly higher belief scores than those with poor adherence (M ± SE: 1.56 ± 0.54, t=2.878, p=0.005). Additionally, patients with higher barrier scores are significantly less adherent than those with lower barrier scores (M ± SE: 4.6 ± 0.85, t=5.531, p<0.001).

**Table 5:** *Comparison of beliefs and barriers scores among adherence groups*

| Score | Adherence (M ± SE) | | Mean difference (M ± SE) | 95% CI | T-test | P value |
|---|---|---|---|---|---|---|
| | Adherent | Non-Adherent | | | | |
| Total beliefs score/40 | 32.26 ± 0.45 | 30.7 ± 0.32 | 1.56 ± 0.54 | 0.48-2.64 | 2.878 | 0.005 |
| Mean beliefs score/5 | 4.03 ± 0.56 | 3.83 ± 0.04 | 0.19 ± 0.07 | 0.05-0.33 | 2.878 | 0.005 |
| Total barriers score/45 | 26.58 ± 0.64 | 31.28 ± 0.56 | 4.6 ± 0.85 | 6.39-3.0 | 5.531 | <0.001 |
| Mean barriers score/5 | 2.95 ± 0.07 | 3.47 ± 0.06 | 0.52 ± 0.09 | 0.71-0.33 | 5.531 | <0.001 |

*M: Mean, SE: Standard error, CI: Confidence interval*

## DISCUSSION

This study aimed to explore factors, beliefs, and barriers associated with adherence to injectable penicillin in children and adolescents with RHD. Most patients (64.2%) were female, with a mean age of 13.3 ± 3 years. Similar demographics have been reported in studies from Uganda, Jamaica, and India, where females represented 78.9%, 74.4%, and 54%, respectively [3,11,10].

A large proportion of patients in our study resided in rural areas (74.6%), consistent with findings from India (69%) and Uganda (60%). In contrast, studies in Egypt have shown a predominance of patients from semi-urban or urban areas [1]. Most participants (61.4%) came from low-income families, with many belonging to social class Ubudehe categories 1 and 2, a finding similar to the Indian study where 73.6% of patients had low socioeconomic status [3]. In Uganda, 68.4% of patients were unemployed [10], while in New Caledonia, Gasse et al. reported a substantial number of households with a higher monthly income [12]. Only 13.4% of guardians in our study had formal employment, contrasting with findings from Jamaica, where 35% were unemployed [11]. Educational attainment was limited, with 46.3% of guardians having completed only primary education, similar to findings from Musoke et al. in Uganda [10]. Conversely, the study from India reported a much higher education rate among participants (65%) [3].
Antibiotic prophylaxis is an effective, cost-efficient measure for preventing recurrent ARF episodes and reducing the burden of RHD. Our study revealed low adherence (46.3%) to secondary prophylaxis with intramuscular penicillin, a trend consistent with similar studies in low-income settings. In the Philippines, Respicio and Sicat found adherence to be 46.6% [13], while adherence was 48.7% in Jamaica [11], 56% in Northern Australia [14], and 58% in Uganda [15]. A Brazilian study noted non-adherence among 35% of children [16].

In this study, poor adherence was significantly associated with unemployed guardians, rural residents, and low educational levels (p=0.022, p=0.001, p=0.027, respectively). Similar patterns have been observed in other regions, such as Egypt, where parental educational and occupational status influenced adherence [17], and Uganda, where city residence and higher education levels were linked to better adherence [18]. In Fiji, urban residence also correlated with improved adherence [19].
Barriers impacting adherence in our study included long distances to clinics and extended waiting times. Similar findings were reported in Jamaica, where barriers included injection pain, school absences, and clinic wait times [11]. Other global studies have cited factors like healthcare costs and perceptions of illness as significant barriers to adherence [20].

This is the first study to examine factors, beliefs, and barriers to secondary prophylaxis adherence in children with RHD in Rwanda. However, it has limitations, including potential acquiescence bias due to self-reported adherence and interviewer-administered questionnaires. Although the principal investigator completed the questionnaires, questions were kept concise to minimize bias and ensure participant understanding. Additionally, the small sample size and specific site limit the generalizability of results.

## CONCLUSION

Adherence to secondary prophylaxis is the most effective way to reduce RHD-related morbidity and mortality. Our study found low adherence to RHD secondary prophylaxis using injectable penicillin at the tertiary care level in Rwanda, with rural residence and parental unemployment being significant contributors to poor adherence. Long distances and clinic wait times were the primary barriers. To enhance adherence to secondary prophylaxis among patients with rheumatic heart disease (RHD), several key recommendations should be implemented. First, healthcare providers must prioritize education for RHD patients and their parents or caretakers, emphasizing the critical importance of adhering to secondary prophylaxis. Second, district hospitals should decentralize RHD prevention activities by extending them to health centers, ensuring greater accessibility and continuity of care. Third, health facilities managing RHD patients should establish registries and Benzathine penicillin injection cards to better track adherence and identify patients who require additional support to improve their adherence levels. Lastly, the Rwanda Biomedical Center (RBC) and the University of Rwanda should conduct a comprehensive study on a larger sample size to accurately determine the level of adherence to secondary prophylaxis across the country.

## REFERENCES

[1] A. Balbaa, A. ElGuindy, D. Pericak, M. Yacoub, and J. Schwalm, "An evaluation of secondary prophylaxis for rheumatic heart disease in rural Egypt," Glob. Cardiol. Sci. Pract., no. 3, p. 40, 2015, doi: 10.5339/gcsp.2015.40.

[2] M. D. Seckeler and T. R. Hoke, "The worldwide epidemiology of acute rheumatic fever and rheumatic heart disease," Clin. Epidemiol., vol. 3, no. 1, pp. 67–84, 2011, doi: 10.2147/CLEP.S12977.

[3] A. AK. Nemani L, Maddury J, Barik R, "Original Article. A Cross-sectional study to look at the determinants of poor adherence to secondary penicillin prophylaxis for rheumatic heart disease at a tertiary care center in South India. J Clin Prev Cardiol 2018;7:5-10.," J. Clin. Prev. Cardiol., vol. 7, pp. 5–10, 2018, doi: 10.4103/JCPC.JCPC.

[4] J. Mucumbitsi et al., "Prevalence of rheumatic valvular heart disease in Rwandan school children : echocardiographic evaluation using the World Heart Federation criteria," vol. 28, no. 5, pp. 285–292, 2017, doi: 10.5830/CVJA-2017-007.

[5] K. M. A. et al. Sulafa, "Acute Rheumatic Fever and Rheumatic Heart Disease : Sudan ' s Guidelines for Diagnosis , Management and Control," vol. 2, 2017.

[6] M. Mirabel et al., "Chirurgie cardiaque : dix ans d'expérience dans deux pays en voie de développement," Arch. Cardiovasc. Dis., vol. 110, no. 2, pp. 82–90, 2017, doi: 10.1016/j.acvd.2016.05.006.

[7] E. K. Rusingiza et al., "Outcomes for patients with rheumatic heart disease after cardiac surgery followed at rural district hospitals in Rwanda," Heart, vol. 0, pp. 1–7, 2018, doi: 10.1136/heartjnl-2017-312644.

[8] E. Marijon, M. Mirabel, D. S. Celermajer, and X. Jouven, "Rheumatic heart disease," The Lancet, vol. 379, no. 9819, pp. 953–964, 2012, doi: 10.1016/S0140-6736(11)61171-9.

[9] J. Manyemba and B. M. Mayosi, "Intramuscular penicillin is more effective than oral penicillin in secondary prevention of rheumatic fever - A systematic review," S. Afr. Med. J., vol. 93, no. 3, pp. 212–218, 2003.

[10] C. Musoke et al., "Benzathine penicillin adherence for secondary prophylaxis among patients affected with rheumatic heart disease attending Mulago Hospital : cardiovascular topics," Cardiovasc. J. Afr., vol. 24, no. 4, pp. 124–129, 2013, doi: 10.5830/CVJA-2013-022.

[11] S. B. Thompson, C. H. Brown, A. M. Edwards, and J. L. M. Lindo, "Low adherence to secondary prophylaxis among clients diagnosed with rheumatic fever , Jamaica," Pathog. Glob. Health, vol. 108, no. 5, pp. 229–234, 2014, doi: 10.1179/2047773214Y.0000000146.

[12] B. Gasse, N. Baroux, B. Rouchon, J.-M. Meunier, I. De Frémicourt, and E. D'Ortenzio, "Determinants of poor adherence to secondary antibiotic prophylaxis for rheumatic fever recurrence on Lifou, New Caledonia: a retrospective cohort study," BMC Public Health, vol. 13, no. 1, p. 131, 2013, doi: 10.1186/1471-2458-13-131.

[13] R. T. Respicio and L. V Sicat, "Clinical Profile and Factors Related to Compliance with Benzathine Penicillin G Prophylaxis among RF / RHD Patients at the Tarlac Provincial Hospital , Philippines," Br. J. Med. Med. Res., vol. 6, no. 7, pp. 699–708, 2015, doi: 10.9734/BJMMR/2015/12084.

[14] T. Stewart, R. Mcdonald, and B. Currie, "Original Article Acute rheumatic fever : Adherence to secondary prophylaxis and follow up of Indigenous patients in the Katherine region of the Northern Territory," Aust. J. Rural Health, vol. 15, pp. 234–240, 2007, doi: 10.1111/j.1440-1584.2007.00896.x.

[15] D. M. Huck, H. Nalubwama, C. T. Longenecker, S. H. Frank, E. Okello, and A. R. Webel, "A Qualitative Examination of Secondary Prophylaxis in Rheumatic Heart Disease," Glob. Heart, vol. 10, no. 1, pp. 63-69.e1, 2015, doi: 10.1016/j.gheart.2014.10.001.

[16] C. F. Pelajo, J. M. Lopez-benitez, J. M. Torres, and S. K. F. De Oliveira, "Adherence to secondary prophylaxis and disease recurrence in 536 Brazilian children with rheumatic fever," Pediatr. Rheumatol., vol. 22, no. 8, pp. 1–5, 2010.

[17] M. A.-F. and G. T. A.Bassili, S.R. Zaher, A. Zaki, "Profile of secondary prophylaxis among children with rheumatic heart disease in Alexandria , Egypt," East. Mediterr. Health J., vol. 6, no. 2/3, pp. 437–446, 2000.

[18] K. Mohammed, W. R. Demissie, and M. B. Gare, "Adherence of Rheumatic Heart Disease Patients to Secondary Prophylaxis and Main Reasons for Poor Adherence at Jimma Medical Center," EJCM, vol. 7, no. 1, pp. 22–27, 2019, doi: 10.32596/ejcm.galenos.2019.00004.

[19] D. Engelman et al., "Adherence to secondary antibiotic prophylaxis for patients with rheumatic heart disease diagnosed through screening in Fiji,"

Trop. Med. Int. Health, vol. 21, no. 12, pp. 1583–1591, 2016, doi: 10.1111/tmi.12796.
[20] K. Petricca, Y. Mamo, A. Haileamlak, E. Seid, and E. Parry, "Original Article. Barriers to effective follow-up treatment for Rheumatic heart disease in Jimma , Ethiopia : A grounded theory analysis of the patient experience," Ethiop. J. Health Sci., vol. 19, no. 1, pp. 39–44, 2009.