CHAPTER 9
Rheumatic Heart Disease Prevention

In most reviews of hospitalizations in sub-Saharan Africa, and in our own experience, rheumatic heart disease (RHD) accounts for around one-third of admissions due to heart failure. In its terminal form, it is a wasting disease that kills young adults and women disproportionately.

RHD is frequently preventable, and is now almost eradicated in the United States. However, it affects more than 60–70 million people worldwide and accounts for at least 1.4 million deaths per year, by one conservative estimate. Ninety-five percent of these deaths take place in the developing countries.

In CHAPTER 4 and CHAPTER 5 of this handbook, we address both the medical management of patients with RHD, including those with mitral stenosis, as well as post-surgical care for those who have required valve replacement or repair. We have shown how integration of these services is possible as part of chronic care for other advanced non-communicable diseases. We also believe that cardiac surgery is an essential service in the poorest countries. This kind of care, known as tertiary prophylaxis (or prevention of death and suffering), will always be needed because of the imperfections of all known prevention strategies, discussed below.

In this chapter, we focus on the role that district NCD leaders can play in the prevention of advanced RHD. We insist on integration of RHD prevention into the job descriptions of health workers tasked with a cluster of related issues.

9.1 Prevention of Acute Rheumatic Fever: Management of Sore Throat

Rheumatic heart disease (RHD) is the deadly complication of rheumatic fever (RF). RF is largely a disease of school-aged children (ages 5 to 15) in which the body’s immune system attacks its own organs, including the heart, the joints, the brain, and the skin. The annual incidence of first attacks of RF in school-aged children is not well characterized in sub-Saharan Africa. Iran has documented the world’s highest incidence rate (25 per 100,000 schoolchildren). RF is thought to result from a reaction to Group A Streptococcal (GAS) throat infections. In susceptible individuals, these bacteria evoke an immune response against the body itself. RHD chiefly involves the cardiac
valves, resulting in variable degrees of regurgitation or stenosis. The best kind of prevention for RHD is prevention of RF.

The need for prevention of RF in low-income countries, also known as primary prophylaxis, may seem obvious, but it has been a surprisingly controversial subject in the expert community. One issue has been the challenge of evaluating and diagnosing GAS pharyngitis. Others have called into question the belief that GAS pharyngitis is the major cause of RF, pointing to recent data on the role of skin infections (pyoderma) in RF among Australian Aborigines. Moreover, early cost models for pharyngitis suggested that primary prophylaxis was not a good value for the money. Despite these disputes, most authorities now recommend integration of pharyngitis and pyoderma management into primary health care protocols such as the Integrated Management of Childhood Illness (IMCI).

In this section, we assume that GAS pharyngitis is the underlying driver of RF in most settings. This is an issue of daily importance for acute care clinicians working at health centers and in the community. District NCD clinicians should also acquire a solid understanding of the issues involved in pharyngitis care.

Controlled trials have repeatedly shown 70% risk reductions in RF incidence through individual treatment of pharyngitis with penicillin and other antibiotics. Countries such as Costa Rica have seen rapid reductions in RF incidence following expansion of primary care services that included sore throat management. Good sore throat management can also reduce symptom time and prevent both pharyngeal abscesses and the dangers of traditional healing. There is also speculation that treating pharyngitis can prevent transmission of GAS infections among school-aged children.

Worldwide, the reported number of sore throat episodes per year per school-aged child varies from as few as 0.02 to as many as 7. FIGURE 9.1 shows the typical fraction of pharyngitis due to GAS in a high-RHD prevalence setting, along with the typical fraction of GAS cases that provoke an attack of acute RF. Even in a setting with such high RF incidence, 250 sore throats would have to be evaluated in order to prevent 1 case of RF.
In many resource-poor settings, at least two barriers exist to effective evaluation and treatment of sore throats. The first is clinical: the difficulty of distinguishing GAS from other, more common causes of pharyngitis such as viral infections. Secondly, parents may not take children to a health care provider for a sore throat. Predictable reasons include the distance to the nearest health facility, user fees, and the sometimes-subtle presentation of pharyngitis. Often parents may find it more convenient to seek care from traditional healers.

One approach to address the limitations of facility-based sore throat management is for community health workers to treat or refer pharyngitis cases using clinical criteria. This approach could be integrated into community-based IMCI. We believe that the need for such an aggressive strategy to manage sore throats depends in part on the underlying prevalence of RHD in the population. Because this prevalence may vary even within a country, national surveys would be helpful. Because Rwanda has not yet undertaken such a survey, sore throat management remains a facility-level issue for now.

It is possible, however, to describe a practical, community-based approach to pharyngitis management for high-RHD prevalence settings. The threshold for determining high prevalence (for example, 0.5% of at least moderate echocardiographic regurgitation in school-aged children) will vary among countries. There are no standards in this regard. We discuss the issues involved in determining RHD prevalence in the section on echocardiographic screening below (see SECTION 9.3.1).

There is a need for an improved set of clinical decision rules to distinguish GAS from other causes of pharyngitis. More than 80% of sore throats in most settings are not due to GAS. Giving antibiotics to these patients costs money, and risks toxicity and allergic reactions without any benefit. Giving penicillin to such patients may breed resistance to other organisms, such as those that commonly cause pneumonia (Streptococcus pneumoniae). The problem of diagnosis can’t be solved by rapid streptococcal antigen tests, which are currently too insensitive to
be relied upon, and culture methods are too cumbersome for routine use in under resourced settings. Clinical criteria (decision rules) for treatment of sore throats with antibiotics have been derived in Egypt, Brazil, the United States, and other countries.\textsuperscript{10-12} These rules vary in their sensitivity and specificity, however. Additionally, there is probably some variation among countries in the clinical presentation of GAS, and yet not every country can afford to develop its own decision rules.\textsuperscript{13}

We have recommended that settings with high RF incidence favor clinical criteria that will result in treatment of most individuals with GAS, even at the risk of some overtreatment. We have also tried to simplify the decision process as much as possible. TABLE 9.1 shows the properties of three decision rules in a pharyngitis population with 24\% GAS.

<table>
<thead>
<tr>
<th>TABLE 9.1</th>
<th>Clinical Decision Rules for Treatment of Pharyngitis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rule 1: WHO\textsuperscript{14}</td>
<td>% with GAS not treated</td>
</tr>
<tr>
<td>Pharyngeal exudate + tender and enlarged cervical lymph nodes</td>
<td>88%</td>
</tr>
<tr>
<td>Rule 2: Steinhoff\textsuperscript{12}</td>
<td>% with GAS not treated</td>
</tr>
<tr>
<td>Pharyngeal exudate OR enlarged cervical lymph nodes</td>
<td>10%</td>
</tr>
</tbody>
</table>

Rule 1 is supported by WHO in its IMCI adaptation guidelines for children under 5 years old.\textsuperscript{11} This rule avoids overtreatment of those without GAS, but undertreats in 88\% of cases.

Rule 2, developed by Steinhoff and colleagues in Egypt, only misses 10\% of GAS cases, but results in treatment of 60\% of patients without GAS.

We have developed a rule based on data from the Egyptian experience in school-aged children, and also a Canadian clinical decision rule tested in populations between the ages of 3 and 76 (PROTOCOL 9.1).
PROTOCOL 9.1  Evaluation and Management of Pharyngitis

This approach begins with treatment of all patients with pharyngeal or tonsillar exudate. This step alone will identify 80% of those with GAS. We believe that the remaining 20% of patients with GAS on culture may well be streptococcal carriers without active infection, and therefore at less risk of developing acute RF. Rather than calling for treatment of all remaining patients who have enlarged cervical lymph nodes, we have recommended a focus on those between the ages of 5–15. If these school-aged children have a combination of two of the following three findings, we would recommend treatment: enlarged or tender cervical lymph nodes, fever ≥ 38°C, or absence of cough and rhinorrhea.

Clinical decision rules should probably be re-evaluated in each particular country. Given the logistical difficulties of obtaining throat cultures, some sites have used rapid streptococcal antigen tests as a gold standard.\textsuperscript{15}

The choice of which antibiotic regimen to use depends on the clinical setting. At the facility level, intramuscular Benzathine Penicillin G is the best option, as it requires only a single injection. This drug carries a small risk of anaphylaxis, and epinephrine should be available. In the
community setting, oral therapy is a better choice, although frequently children will stop taking their medication once symptoms improve. If adherence with oral therapy is felt to be poor, community health workers should continue follow-up of these cases until the antibiotic regimen is completed. TABLE 9.2 and TABLE 9.3 show typical regimens for pharyngitis treatment and their associated costs and risks.

TABLE 9.2 Antibiotic Regimens for Streptococcal Pharyngitis (Adults and Adolescents Dosing, Weight ≥ 27 kg)

<table>
<thead>
<tr>
<th>Regimen</th>
<th>Doses</th>
<th>Cost</th>
<th>Allergic Reactions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oral penicillin VK</td>
<td>500 mg, two times per day for 10 days</td>
<td>20</td>
<td>$0.66</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Cutaneous 1%-2%</td>
</tr>
<tr>
<td>Intramuscular benzathine penicillin G</td>
<td>1.2 million units, single dose</td>
<td>1</td>
<td>$0.14</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Cutaneous 1%-2%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Anaphylaxis 0.02%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Death 0.003%</td>
</tr>
<tr>
<td>Oral erythromycin (75 kg adult)</td>
<td>250 mg, four times per day</td>
<td>12</td>
<td>$6.38</td>
</tr>
</tbody>
</table>

TABLE 9.3 Antibiotic Regimens for Streptococcal Pharyngitis (Pediatric Dosing, Weight ≤ 27 kg)

<table>
<thead>
<tr>
<th>Regimen</th>
<th>Doses</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oral penicillin VK</td>
<td>250 mg, two times per day for 10 days</td>
<td>20</td>
</tr>
<tr>
<td>Intramuscular benzathine penicillin G</td>
<td>600,000 units, single dose</td>
<td>1</td>
</tr>
<tr>
<td>Oral erythromycin</td>
<td>12.5 mg/kg, three times per day for 3 days</td>
<td>9</td>
</tr>
</tbody>
</table>

9.2 Preventing Rheumatic Heart Disease: Management of Acute Rheumatic Fever and Secondary Prophylaxis for Rheumatic Fever

Rheumatic fever is a disease that primarily affects school-aged children (ages 5 to 15). There are no treatments shown to improve the outcome. However, diagnosis and follow-up is important because chronic antibiotic therapy can prevent RF recurrence. This intervention probably reduces the risk of RF recurrence by more than 50%.18

Secondary prophylaxis for RHD should be integrated into chronic care services at the health center level. District NCD clinicians play a critical role in secondary prophylaxis of RHD. These providers have the basic echocardiography skills to rule-out cardiomyopathies, dramatic endocarditis, or alternative causes of significant murmurs. These providers can also organize patients for evaluation by specialists.
Cardiologists or echocardiographers working at referral centers are essential to confirm the diagnosis of RHD echocardiographically and evaluate patients for possible cardiac surgery. Registration of RHD cases should be done as part of an integrated electronic medical record system at both district and referral center levels.

9.2.1 Acute Rheumatic Fever: Diagnosis and Follow-Up

For the most part, acute care clinicians staffing general consultation clinics identify RF cases. Patients are then referred to the nearest district hospital for admission. At discharge, patients are sent to their nearest chronic care clinic for follow-up.

There is no blood test or imaging study to diagnose acute rheumatic fever. Clinical criteria are based on experience in the United States. These criteria, named after T. Duckett Jones, have gone through at least 5 revisions. Over time, the criteria became increasingly stringent to avoid overdiagnosis of RF, since the incidence of the disease was declining. The most recent recommendations require confirmation of at least two major criteria, or a combination of one major and at least two minor criteria (TABLE 9.4). The guidelines also require objective evidence of a preceding group A streptococcal infection (including elevated or rising ASO titers, or positive microbiologic tests).

The 2007 Australian guidelines for RF and RHD have modified the Jones criteria for use among high-risk groups such as the Aborigines. The Australian guidelines add two additional major criteria: monoarthritis and evidence of subclinical carditis by echocardiography. The guidelines assume access to complete echocardiography and microbiologic testing.

<table>
<thead>
<tr>
<th>Major criteria (five)</th>
<th>Minor criteria (four)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carditis or subclinical</td>
<td>Clinical</td>
</tr>
<tr>
<td>echocardiographic carditis</td>
<td>1. Fever $\geq 38$˚C</td>
</tr>
<tr>
<td>2. Polyarthritis or monoarthritis</td>
<td>2. Arthralgia</td>
</tr>
<tr>
<td>3. Chorea</td>
<td>Laboratory</td>
</tr>
<tr>
<td>4. Erythema marginatum</td>
<td>3. Elevated acute phase reactants (erythrocyte sedimentation rate $\geq 30$ mm/h)</td>
</tr>
<tr>
<td>5. Subcutaneous nodules</td>
<td>4. PR-interval prolongation</td>
</tr>
</tbody>
</table>

There are several problems with even these modified Jones criteria in low-resource environments with a high incidence of acute RF. First, it may be difficult to fulfill the requirement that there be objective evidence of a preceding streptococcal infection. Neither rapid streptococcal antigen tests nor antistreptolysin O titers alone are particularly sensitive, and neither is available at the district hospital level. Throat culture is also
unavailable and has a long turn-around time. The Jones criteria did not require evidence of a streptococcal infection until the 1965 revision.

Second, there is a need for simplified guidance based on the most common presentation of the disease.

In our experience, a great deal of weight should be put on the finding of overt carditis with loud murmurs in the age group at risk (5 to 25 years old). A review of initial RF cases in India found that one-third had carditis at the time of presentation. In our experience, the majority of RF cases in sub-Saharan Africa present with carditis. Erythema marginatum and subcutaneous nodules are rare manifestations. Patients with the finding of clinical carditis or of chorea who otherwise meet the Jones criteria should not require confirmation of a streptococcal infection.

Endocarditis is an important alternative diagnosis to consider. All patients should have basic echocardiography performed at the district level as well as referral for complete echocardiography.

Patients with polyarthritis or monoarthritis as their sole major criteria are more challenging to diagnose with acute RF. The differential diagnosis includes viral as well as gonococcal arthritis. Diagnosis of RF in these cases should probably require evidence of streptococcal infection—even in resource-limited settings.

There are no therapies shown to improve the outcome of acute rheumatic fever. However, the studies on this subject date back to the 1950s and 1960s. Due to the lack of high-quality evidence, decision-making in this area relies on expert opinion. Our practice is to hospitalize all patients with suspected acute RF for several weeks. We administer IM benzathine penicillin G (see TABLE 9.3). For patients with carditis, we administer prednisone at a dose of 1 mg per kg, divided over 2 doses.

Once patients are discharged, they are referred to the NCD clinic, and penicillin is continued chronically. Patients are given the option of either oral penicillin V or benzathine penicillin G, given on a monthly basis (see TABLE 9.5). Treatment should be continued for 10 years, or until age 21, whichever is longer. For those with severe disease, or those who have undergone cardiac surgery, treatment should continue indefinitely.

One practice is to follow the erythrocyte sedimentation rate (ESR) on a weekly basis and begin to taper the steroid dose once the ESR has normalized (≤ 20 mm/hr).
TABLE 9.5  Antibiotic Regimens for Secondary Prophylaxis of Rheumatic Fever

<table>
<thead>
<tr>
<th></th>
<th>Adults (≥ 27 kg)</th>
<th>Children (≤ 27 kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oral penicillin VK</td>
<td>500 mg, two times per day</td>
<td>250 mg, two times per day</td>
</tr>
<tr>
<td>Intramuscular benzathine penicillin G</td>
<td>1.2 million units, once every 4 weeks</td>
<td>600,000 units, once every 4 weeks</td>
</tr>
<tr>
<td>Oral erythromycin (penicillin allergy)</td>
<td>250 mg, two times per day</td>
<td>10 mg/kg, twice per day</td>
</tr>
</tbody>
</table>

For decades, benzathine penicillin G administered monthly has been the standard of care for secondary prophylaxis of RHD. There have been concerns about compliance with oral regimens and studies dating back to the 1950s have shown the superiority of intramuscular injections. In practice, however, compliance with intramuscular regimens has been poor.\(^{27,28}\)

We believe that, given the seriousness of RHD, care of this disease merits the support of community health workers. As others have noted, the studies comparing oral and IM penicillin were conducted prior to the introduction of oral penicillin V.\(^{18}\) Additionally, studies have shown that penicillin levels decline in blood two weeks after benzathine injection.\(^{29,30}\) Given the difficulty of twice-monthly injections, we believe there is a strong case for directly observed therapy with oral penicillin V.

9.3  Rheumatic Heart Disease Screening

We have already discussed some of the challenges in RHD prevention. For example, a community survey in rural Pakistan found that only 19 percent of those with findings of RHD on echocardiography were aware of their disease.\(^{31}\) Almost half of those identified with RHD could not recall symptoms consistent with acute rheumatic fever. Fewer than half of those individuals aware of their disease were receiving antibiotic prophylaxis.

The presentation of GAS pharyngitis may be subtle, and acute RF may be difficult recognize. By the time that patients with RHD present for care, the disease may be so advanced that secondary prophylaxis is of limited value. Patients with milder forms of the disease stand to benefit most from chronic penicillin, but these patients are least likely to be identified. Given these considerations, there have been efforts to screen high-risk groups—school-aged children, primarily—for RHD for more than half a century.\(^{32}\)

However, screening is not yet an established approach to RHD prevention for several reasons. Because there are no blood tests to diagnose RHD, screening relies on either listening for murmurs, or looking for disease with cardiac ultrasound. Dramatic disease (at least moderate in
severity) is not very prevalent. Milder disease is difficult to differentiate from normal variation using these tests, and the natural history of this disease is unknown. Trials of penicillin prophylaxis were performed in individuals who had recently experienced an episode of acute RF, not in asymptomatic populations identified through screening. In fact, screening in the United States became less popular as the prevalence of the disease declined, and concerns about misdiagnosis grew.33,34

In developing countries, screening has been promoted, but has never contributed substantially to case finding. The 1986 to 1990 WHO program for the prevention of RHD incorporated school-based screening—mainly listening for murmurs—as part of its case-finding activities.27 These surveys identified 3135 suspected RHD cases out of more than 1.4 million children screened (0.2%). Screening, however, only accounted for 9% of the total RHD cases registered during this period (mainly through review of existing records).

### 9.3.1 Echocardiographic Screening for Rheumatic Heart Disease

Since the introduction of echocardiography in the 1980s, it has become increasingly apparent that listening for heart murmurs is not a reliable way to identify mild valvular disease. This technique consistently identifies problems in children who do not have any actual disease. For example, a study in Pakistan has shown that more than a third of RHD cases initially identified through auscultation did not have any signs of heart disease by echocardiography.35 Another study found that a quarter of school-aged children have some kind of heart murmur. Only 2% of those thought to have murmurs actually had suspected RHD by echocardiography.36,37

At the same time, screening with echocardiography has its own problems. Investigators in Kenya published the first pilot study of primary echocardiographic screening for RHD in 1996.38 Unclear as to the significance of the trivial lesions identified by ultrasound in around 6% of schoolchildren, the group initially randomized these patients to penicillin prophylaxis, but the project stopped prematurely due to logistical difficulties.

Since that time, groups in Mozambique, Cambodia, Fiji, Tonga, and other sites have been honing echocardiographic screening techniques.36,39-41

Recent echocardiographic prevalence studies have found a variable rate of definite RHD in school-aged children (see TABLE 9.6). These patients generally had mild disease with an uncertain prognosis. Assuming a prevalence of 0.5%, it would take at least a working week for an echocardiographer to identify one definite case of RHD (assuming 10 minutes per study, 5 hours a day, 5 days a week). This kind of effort
could be justified given the seriousness of the disease (around $600 per case found), but training in even basic echocardiography is rare in sub-Saharan Africa.

TABLE 9.6  Echocardiographic Prevalence of Definite and Possible RHD in School-Aged Children

<table>
<thead>
<tr>
<th>Country</th>
<th>N</th>
<th>Setting</th>
<th>Population</th>
<th>Definite or probable RHD</th>
<th>Possible RHD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paar et al. 2010</td>
<td>3150</td>
<td>Rural and urban</td>
<td>Community</td>
<td>0.6%</td>
<td>2.4%</td>
</tr>
<tr>
<td>Steer et al. 2009</td>
<td>3462</td>
<td>Rural and urban</td>
<td>School-based</td>
<td>0.8%</td>
<td>n/a</td>
</tr>
<tr>
<td>Carapetis et al. 2008</td>
<td>5053</td>
<td>Rural and urban</td>
<td>School-based</td>
<td>3.3%</td>
<td>0.5%</td>
</tr>
<tr>
<td>Marijon et al. 2007</td>
<td>3677</td>
<td>Urban</td>
<td>School-based</td>
<td>3.0%</td>
<td>n/a</td>
</tr>
<tr>
<td>Marijon et al. 2007</td>
<td>2170</td>
<td>Urban</td>
<td>School-based</td>
<td>2.1%</td>
<td>n/a</td>
</tr>
<tr>
<td>Anabwani and Bonhoeffer</td>
<td>1115</td>
<td>Rural and urban</td>
<td>School-based</td>
<td>0.3%</td>
<td>7.3%</td>
</tr>
</tbody>
</table>

The clinical viability of echocardiographic screening depends on efforts to increase diagnostic yield. One strategy may be to focus on screening of older schoolchildren who appear to have a higher prevalence of disease. Another important observation has been that an additional 2% to 4% of schoolchildren have borderline echocardiographic abnormalities consistent with possible RHD. At present, the benefit of penicillin in these cases is unclear, and the harm is evident. Groups are currently at work to define standard diagnostic criteria for possible RHD, and to design trials of penicillin prophylaxis for these individuals. Arguably, criteria for definite RHD should be more conservative than those used in many studies.

If echocardiographic screening develops into an attractive prevention strategy, we believe that district NCD clinicians could be a valuable resource. These clinicians have basic echocardiographic skills and could spend a small portion of their time doing school outreach.

9.3.2  Studies of RHD Prevalence

Despite the limitations of echocardiographic diagnosis for mild RHD, some sense of the prevalence of RHD in the community is critical for the design of prevention strategies. For example, in some settings it might make sense to allow community health workers to assess and treat sore throats directly. Countries should engage in echocardiographic screening to obtain prevalence data as part of efforts like the ASAP (Awareness, Surveillance, Advocacy, and Prevention) initiative in Africa.
Countries should consider integration of these studies into larger school health surveys if there are gaps in this area more generally.

There have been a variety of proposed criteria for diagnosis of asymptomatic RHD (see Table 9.7).\textsuperscript{24,44,45} Criteria vary in whether they put more weight on valvular regurgitation or thickening. Some criteria have also insisted on the presence of an audible murmur in addition to echocardiographic findings. None of these criteria have been evaluated prospectively. The vast majority of suspected RHD identified by these criteria is trivial or mild. For example, only 11% of RHD thought definite in one echocardiographic survey was of moderate or greater severity.\textsuperscript{39}

<table>
<thead>
<tr>
<th>Properties of regurgitant jet</th>
<th>World Health Organization 2001\textsuperscript{24}</th>
<th>Marijon et al. 2009\textsuperscript{44}</th>
<th>Preliminary World Health Organization/United States National Institutes of Health 2005\textsuperscript{37}</th>
</tr>
</thead>
<tbody>
<tr>
<td>Holosystolic (mitral) or holodiastolic (aortic) regurgitation visible in at least two color planes with $\geq 1$ cm extension and a velocity $\geq 2.5$ m/s</td>
<td>Any degree in two planes</td>
<td>Definite</td>
<td>Probable</td>
</tr>
<tr>
<td>Morphologic abnormalities</td>
<td>Not required</td>
<td>Required\textsuperscript{**}</td>
<td>Required\textsuperscript{***}</td>
</tr>
<tr>
<td>Pathologic murmurs</td>
<td>Not required</td>
<td>Not Required</td>
<td>Required</td>
</tr>
</tbody>
</table>

\textsuperscript{*} $\geq 1$ cm of jet length is sufficient for aortic regurgitation.

\textsuperscript{**} Any two of the three that include leaflet tethering, leaflet thickening, or sub-valvular thickening.

\textsuperscript{***} For mitral regurgitation, these include thickening of the valve or a hockey-stick/elbow deformity of the anterior leaflet; in addition, for mitral stenosis, these also include tethering of the posterior leaflet, commissural thickening and calcification with a mean gradient $\geq 4$ mmHg; for aortic regurgitation without obvious non-rheumatic causes, these include morphologic abnormalities of the mitral valve.

\textsuperscript{****} Either significant left-sided valvular regurgitation, morphologic abnormalities, or mitral stenosis in the presence of pathologic murmurs.

Because of uncertainty about the importance of mild lesions on echocardiography, we propose that prevalence surveys place more weight on definite disease. At the same time, auscultation alone is not helpful and emphasis should be put on echocardiographic diagnosis (see Table 9.8).
TABLE 9.8 Proposed Criteria for Definite and Possible RHD

<table>
<thead>
<tr>
<th></th>
<th>Definite</th>
<th>Possible</th>
</tr>
</thead>
<tbody>
<tr>
<td>Properties of regurgitant jet</td>
<td>At least mild-to-moderate regurgitation. Regurgitation visible in at least two color planes</td>
<td>Any degree in two planes</td>
</tr>
<tr>
<td>Morphologic abnormalities</td>
<td>Required*</td>
<td>Required*</td>
</tr>
<tr>
<td>Pathologic murmurs</td>
<td>Not required</td>
<td>Not Required</td>
</tr>
</tbody>
</table>

PROTOCOL 9.2 Screening for Rheumatic Heart Disease
(and Other Conditions of School-Aged Children)

1. History: any recollection of severe joint pain, shortness of breath. Consider screening questions for epilepsy, musculoskeletal disabilities, asthma
2. Physical examination: height and weight, auscultation. Consider physical examination for other conditions (e.g., skin infections)
3. Consider screening laboratory tests for anemia, proteinuria, HIV
4. Screening echocardiography (restricted to parasternal long and apical 4-chamber views).

Meet echocardiographic Criteria for definite RHD (see Table 9.5)

1. Initiate antibiotic prophylaxis (oral OR IM)
2. Assign a community health worker

Refer to district NCD clinic

1. Council regarding sore throat management
2. Participate in randomized trial of antibiotics if available
3. Assign a community health worker
4. Follow-up every 6 months at district NCD clinic.

Follow-up plan for other identified conditions
Finally, there should be a plan in place to follow up for individuals identified with borderline lesions. One approach may be more vigilant treatment of pharyngitis episodes rather than continuous RF prophylaxis. Another approach may be to enroll these patients in randomized trials of prophylaxis strategies. **Protocol 9.2** shows a proposed approach for RHD prevalence studies.
Chapter 9 References

20 Jones TD. The diagnosis of rheumatic fever. JAMA 1944;126:481-87.
30 Kaplan EL, Berrios X, Speth J, Siefertman T, Guzman B, Quesny F. Pharmacokinetics of benzathine penicillin G: serum levels during the 28 days after intramuscular injection of 1,200,000 units. J Pediatr 1989;115:146-50.


