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Cost-Utility Analysis of Clinical Decision Rules for Group A Streptococcal Pharyngitis Management in Jamaica: A Markov Modelling Study

Yohance Rodriguez[1], Camille-Ann Thoms Rodriguez[2], J Peter Figueroa[1]

ABSTRACT

Background

Group A Streptococcal (GAS) pharyngitis management requires clinical expertise to differentiate viral from bacterial aetiology, and also balancing antibiotic stewardship with prevention of acute rheumatic fever (ARF) and rheumatic heart disease (RHD). Jamaica maintains an active ARF and RHD control programme, yet antibiotic overuse remains problematic. This study evaluates the cost-utility of implementing clinical decision rules (CDR) with rapid antigen detection tests (RADT) compared to current pharyngitis management practices.

Methods

We conducted cross-sectional surveys at 22 public health centres and two insurance companies in Kingston and St Andrew to determine 2018 pharyngitis incidence, and at five regional hospitals to calculate direct RF and RHD costs. Data were incorporated into a Markov model comparing four strategies: no treatment, current empirical practice, universal antibiotic treatment, and CDR-guided management with RADT. The model adopted a healthcare system perspective with an 81-year time horizon. Costs were expressed in 2018 US dollar value. Deterministic and probabilistic sensitivity analyses examined parameter uncertainty.

Findings

The CDR strategy dominated all alternatives in both discounted and undiscounted analyses, demonstrating lowest lifetime costs ($7.92 per patient) and highest Disability-adjusted Life Years (DALYs) averted. Compared to current practice, CDR implementation would save $21.84 per person while improving health outcomes. At 15.7% of Jamaica's 2018 weekly minimum wage, the intervention represents highly acceptable expenditure. Probabilistic sensitivity analysis confirmed CDR dominance with 99% probability of cost-effectiveness at a willingness-to-pay threshold of three GDPs per capita.

Interpretation

Despite implementation costs, including clinician training, protocol development, and RADT procurement, CDR-guided pharyngitis management offers superior clinical outcomes and cost savings compared to current practice in Jamaica. These findings support WHO recommendations for improved GAS pharyngitis diagnostics in RF and RHD prevention programmes and provide actionable evidence for health policy makers in Jamaica and similar resource-limited settings.

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INTRODUCTION

Acute rheumatic fever (ARF) and rheumatic heart disease (RHD) remain significant causes of cardiovascular morbidity and mortality in low- and middle-income countries (LMICs), despite being largely eliminated in high-income nations. Globally, RHD affects an estimated 33 million people and causes over 300,000 deaths annually, with the highest burden in regions with limited healthcare resources (1). Group A beta-haemolytic Streptococcus (GAS) pharyngitis is the primary preventable antecedent of ARF. Prompt antibiotic treatment of GAS pharyngitis can prevent ARF development, forming the cornerstone of primary prevention strategies. However, distinguishing GAS pharyngitis from viral pharyngitis based on clinical features alone is unreliable, leading to both antibiotic overuse when viral infections are misdiagnosed and GAS infections are not recognized, missing treatment opportunities. Jamaica established its ARF and RHD control programme in 1984 as part of the World Health Organization (WHO) International Programme for Prevention of ARF and RHD (2). The programme encompasses primary prevention through appropriate pharyngitis management, secondary prevention via penicillin prophylaxis, health worker capacity building, and disease surveillance. Despite these efforts, challenges persist, particularly regarding antibiotic stewardship in pharyngitis management (3).The WHO Director-General 2019 report on RHD emphasized the importance of rapid antigen detection tests (RADTs) for point-of-care diagnosis and promotion of appropriate antibiotic use for GAS pharyngitis (4). Clinical decision rules (CDRs), such as the Centor and McIsaac scores, have demonstrated utility in high-income settings for identifying patients who would benefit from throat culture or RADT (5,6). However, evidence regarding their cost-effectiveness in resource-limited settings remains limited (5). This study evaluates the cost-utility of implementing CDR-guided pharyngitis management with RADT support in Jamaica, comparing this strategy against current empirical practice, universal treatment, and no treatment. By providing economic evidence alongside clinical effectiveness data, we aim to inform health policy decisions regarding RF and RHD prevention in Jamaica and similar LMIC contexts.

METHODS

Study Design and Perspective

We conducted a cost-utility analysis using Markov modelling to evaluate four pharyngitis management strategies following a starting disease-free cohort of children 0-15 years old (623,843 in 2018), over an 81-year time horizon (lifetime for a school-aged child presenting with pharyngitis). The analysis adopted a healthcare system perspective, including direct medical costs borne by the Jamaican public healthcare system and private insurers.

Data Collection

Pharyngitis Incidence

We conducted cross-sectional surveys at all 22 public health centres in the Kingston and St Andrew corporate area providing medical services during 2018 (7). Patient records were reviewed to identify pharyngitis cases, with follow-up visits within seven days counted as a single episode. For private sector incidence, we obtained anonymized claims data from two major insurance providers covering over 80% of the privately insured population. Private sector incidence was extrapolated using population proportions and age-specific infection rates. The incidence of pharyngitis was calculated from the total number of cases (in 0-15 year olds) reported within the jurisdiction of interest (7,142) divided by the population of 0-15 year olds in 2018 (150,500) (See Table 1)

Table 1: Descriptions of Transition Probabilities used in the Current Pharyngitis Management Scenario

Scenario 1:	CURRENT MANAGEMENT		
Probability	pP_c (0.0474)	pRF_c (0.000097)*	pD_c (0.00645)
	Probability of Pharyngitis	Probability of RF Events	Probability of death from RF events
Description	Given by the calculated local incidence of pharyngitis in the 0–15-year-old age group.	Given by the average number of new ARF cases in Jamaica 2015-2018 in 0–15-year-olds over estimated annual number of cases of pharyngitis in Jamaica, 2015-2018	Given by the 2018 incidence of death from all cases in the RF registry (includes ARF, RRF, RHD)
Calculation	pP_c=7142/150550	pRF_c = 3 / 30,908	pD_c =9/1387
Source(s)	Study data	Study data	Study data

***Applied to 9-35 year olds**

Cost Data

Direct medical costs were obtained from multiple sources. Outpatient consultation fees, diagnostic tests, and medication costs were derived from the National Health Service (Fees)(Amendment) Regulations 2009. Hospitalization costs for ARF and RHD complications were calculated from detailed reviews of 2018 admissions at five regional hospitals (Kingston Public Hospital, Bustamante Hospital for Children, University Hospital of the West Indies, Cornwall Regional Hospital, and the St Ann's Bay Hospital). Costs included ward fees, specialized care (intensive care, cardiac surgery), diagnostic procedures, medications, and physician fees. RADT costs were based on international market prices for high-sensitivity tests (sensitivity 95%, specificity 95%), unadjusted for bulk procurement discounts and importation costs. All costs were converted from Jamaican dollars to US dollars using the 2018 average exchange rate (JMD 129.72 = USD 1.00) and inflated to 2018 values using the US Consumer Price Index wherever necessary.

Effectiveness Parameters

Clinical effectiveness parameters, including GAS prevalence in pharyngitis, antibiotic effectiveness in preventing ARF, RADT sensitivity and specificity, and CDR performance characteristics, were derived from the literature. Disability weights for health states were obtained from the Global Burden of Disease Study 2019 (8). Transition probabilities were based on the incidence of ARF, Recurrent RF (RRF), RHD and other RF complications, calculated from reconciled data (National Surveillance Unit and secondary care facilities) (9). The 2018 mid-year 0-15 year old Jamaican population (150,500), available from the Statistical Institute of Jamaica (STATIN), was used as the denominator.

Model Structure

We developed a Markov cohort model with annual cycles tracking a hypothetical cohort of school-aged children presenting with pharyngitis through their lifetime. Health states included: well (no pharyngitis), acute pharyngitis (viral or GAS), acute rheumatic fever (including Recurrent Rheumatic fever, RRF), rheumatic fever-associated events together (including heart disease, carditis, heart failure), and death (see Figure 1:

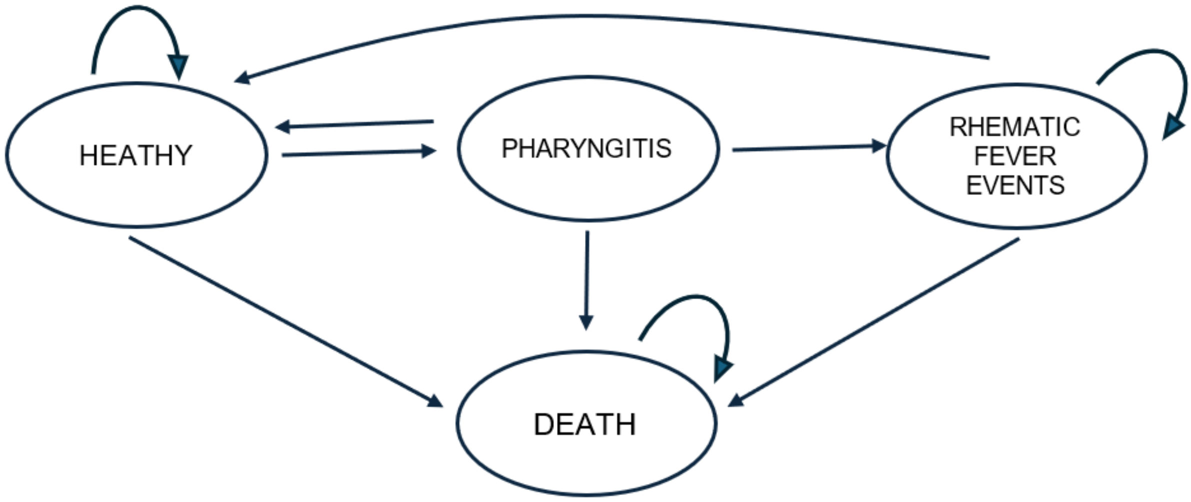

Figure 1: Markov Transition Probability Tree Used for the Local Rheumatic fever Sequalae, from Healthy to Terminal Transition

Transition Probability Tree). Patients could transition between states based on age-specific and disease-specific transition probabilities. Stroke, surgical outcomes and other discrete sequelae were excluded as delineated health states, as the cost of these health states were not examined separately in the cost of care data abstraction. Instead, they were assumed to contribute to overall RF-associated mortality already considered in the health states used. The model assumed that untreated GAS pharyngitis carries a 0.3% risk of progressing to ARF. Risk of progression from one health state to another was calculated using locally-available and literature-based disease incidence (Tables 1-3).

Table 2: Descriptions of Transition Probabilities used in the Treat All Pharyngitis Management Scenario

Scenario 2:	**TREAT ALL**		
Probability	pP_{TA} (0.0474)	pRF_{TA} (0.000027)*	pD_{TA} (0.00645)
	Probability of pharyngitis	Probability of ARF	Probability of death from RF events
Description	Given by the calculated local incidence of sore throat (P, TP, T, ST) in the 0-15 year-old age group.	Probability of ARF if all presenting sore throat cases (with 30% GAS prevalence) were treated with penicillin-based antibiotics, and only treatment failure (3%) had risk of ARF (0.3%).	Given by the 2018 incidence of death from all cases in the RF registry (includes ARF, RRF, RHD)
Calculation	pP_{TA} =7142/150550	pRF_{TA}=0.3x0.03x0.003	pD_{TA}=9/1387
Source(s)	Study data	Literature	Study data

Applied to 9-35 year olds

Table 3: Descriptions of Transition Probabilities used in the Clinical Decision Rule Pharyngitis Management Scenario

Scenario 3:	**Clinical Decision Rule**		
Probability	pP_{CDR} (0.0474)	pRF_{CDR}(0.00001195)*	pD_{CDR} (0.00645)
	Probability of pharyngitis	Probability of ARF	Probability of death from RF events
Description	Given by the calculated local incidence of sore throat (P, TP, T, ST) in the 0-15 year-old age group	Probability of ARF if CENTOR scores of ≥3 were treated with penicillin-based antibiotics, and only treatment failure (3%) had risk of ARF (0.3%). The probability of GAS is given by the sum of weighted CENTOR_GAS probabilities, ie probabilities of GAS per CENTOR score, by proportion of recorded cases per score	Given by the 2018 incidence of death from all cases in the RF registry (includes ARF, RRF, RHD).
Calculation	pP_{CDR} =7142/150550	pRF_{CDR}= (((7/100)x(21/256))+((12/100)x(123/256))+((21/100)x(83/256))+(((37/100)x(29/256))x 3/100))x3%x0.3/100	pD_{CDR} =9/1387
Source(s)	Study data	Literature	Study data

***Applied to 9-35 year olds**

Strategy 1: No Treatment (Baseline) - Represents natural disease progression without primary prevention. Patients receive symptomatic care only.

Strategy 2: Current Practice - Empirical antibiotic treatment based on clinical judgment without structured assessment. Reflects current Jamaican practice with approximately 91% of pharyngitis patients receiving antibiotics.

Strategy 3: Treat All - Universal antibiotic treatment for all pharyngitis presentations, ensuring no GAS cases are missed but maximizing antibiotic exposure.

Strategy 4: Clinical Decision Rule - Structured assessment using validated CDR (modified Centor score **[Table 4]**) to stratify risk (Table 5). Low-risk patients receive symptomatic care; intermediate-risk undergo RADT with treatment based on results; high-risk receive empirical antibiotics.

Table 4: Centor Scoring System for Antibiotic Indication in Pharyngitis

Criteria	**Score**
Cough absent	1
Exudate	1
Nodes (tender anterior cervical)	1
Temperature >38° C	1
Young **OR** Old	
• Age 3-14	1
• Age 15-44	0
• Age >44	-1

Source: Centor Score (modified) for GAS Pharyngitis - Estimate likelihood of GAS pharyngitis (26)

Table 5: American College of Physicians/Centers for Disease Control and Prevention Guidelines for the Management of Pharyngitis and FeverPain scale and GAS risk

Centor score	American College of Physicians/ Centers for Disease Control and Prevention Guidelines	Risk of group A or C Pharyngitis (%)	Incidence of GAS (%)
0-1	Do not test, Do not treat	1-10	7
2	Treat if rapid test positive	11-17	12
3	ACP/CDC option 1: Treat if rapid test positive, or ACP/CDC option 2: Treat empirically	28-35	21
≥4	Treat empirically	51-53	37

Source: Pharyngitis (27) and FeverPain scale GAS risk (5).

Analysis

Costs and health outcomes were discounted at 3% annually, following WHO guidelines for economic evaluation. Health outcomes were measured in disability-adjusted life years (DALYs) averted. DALYS were calculated by multiplying life years in each health state by the corresponding utility weight plus years of life lost.

DALY = YLL + YLD

YLL (Years of Life Lost) = N x LE

N = Number of deaths

LE = Standard life expectancy at age of death

YLD (Years Lived with Disability) = N x DW x AD

- **I = Number of incident cases**
- **DW = Disability weight**
- **AD = Average duration of the case**

DALYs averted was calculated by subtracting incremental DALYs of each state from that of the baseline (No treatment) state. Incremental cost-effectiveness ratios (ICERs) were calculated by dividing incremental costs by incremental DALYs averted for each strategy. Cost-effectiveness was interpreted using Jamaica's GDP per capita (estimated US$5,578.10 in 2018) (10) as the willingness-to-pay threshold, following WHO guidelines that interventions costing less than one to three GDP per capita per DALY averted are highly cost-effective (11).

Sensitivity Analyses

Sensitivity analyses were conducted to assess the robustness of the model. One-way sensitivity analysis was conducted on input parameters of interest, i.e. probabilities of having pharyngitis, progressing to RF events and death from RF, and costs of pharyngitis and RF-associated events. To identify parameters with the greatest influence on the ICER, probabilities ranged across 95% confidence intervals, while costs were varied by 10%. Probabilistic sensitivity analysis (PSA) was performed using Monte Carlo simulation (5,000 iterations) in Microsoft Excel using the same parameters. Transition probabilities were assigned Beta distributions and costs were assigned Gamma distributions. PSA results were presented using a cost effectiveness plane and a cost-effectiveness acceptability curve (CEAC) at different willingness-to-pay thresholds.

Table 6: Comparative Costs of Six (6) Commercially Available Point of Care GAS Screening Kits

Manufacturer/ Product Name	Preparation	Cost per test	Year cost was stated	Adjusted to 2018 US$	Sensitivity/ Specificity	Sources of information
StrepAim 73025	US$41.05 for 25 tests	US$1.64	2022	1.45		(28)
Dealmed Rapid Diagnostic Strep A	US$36.99 for 25 tests	US$1.48	2022	1.31	99%/ 95%[a]	(29),(30)
Preview Strep A test kit	US$55.35 for 25 tests	US$2.21	2022	1.96		(31)
Sekisui Diagnostics OSOM Strep A	US$129.99 for 50 tests	US$2.60	2022	2.30	96%/ 98%[b] 95%/100% [c]	(32)
IMI Test Pack Plus	-	£3.15	2008	5.99	95%/ 100%[c]	(33)
Streptatest	-	£1.38	2008	2.62	97%/ 95%	

a. Overall clinical accuracy in rare and 1+ colonies vs culture
b. Manufacturer's report
c. Externally validated

Table 7: Derivation of RF Spectrum Disability Weighting by Case-proportioned Combination of WHO Disability scores of ARF, RHD and Heart Failure

Disease State	Number of visits	% of Annual visits	Weighted disability score*	Combined weighted disability**
ARF/RRF	38	0.59375	0.005	0.00296875
Heart failure	6	0.09375	0.179	0.01678125
RHD	20	0.3125	0.041	0.0128125
TOTAL	**64**	**1**	**-**	**0.03209375**

**Source: Global Burden of Disease Study (8). **Weighted disability x % Annual visits*

RESULTS

Base-Case Analysis

The League table (Table 8) presents the base-case cost-utility results for all four strategies. In non-discounted and discounted analysis, the CDR strategy was dominant, providing the greatest health benefit (0.141 DALYs averted per patient) at the lowest lifetime cost ($7.92 per patient). Compared to current practice, CDR implementation would save $21.84 while averting 0.014 DALYs more per patient, representing both cost savings and improved health outcomes.

Table 8: League Table Comparing Incremental Cost-effectiveness Ratios (ICERs) for Each Scenario Compared to the No Primary Prevention Scenario

Scenario	*DALYs*	*Costs (USD)*	DALYs averted	Incremental Cost (USD)	ICER ($/DALY)	% of Weekly Minimum Wage (Jamaica 2018 (Ja$7000/ US$56.96)
No Treatment	13.110	32.49				
1: Current	12.982	29.76	0.128	-2.732268435	0.046743549	0.082%
2: Treat All	12.971	29.52	0.139	-2.970779664	0.046743856	0.082%
3: Clinical Decision Rule	12.969	7.92	0.141	-24.57052034	0.005749227	0.010%

The Treat All strategy was found to prevent more ARF cases and was more cost saving than current practice, not including associated adverse events. The no-treatment baseline demonstrated the poorest health outcomes (13.11 DALYs/patient) and the highest costs due to downstream ARF and RHD management expenses. Extended dominance analysis eliminated current practice and treat-all strategies. The ICER for CDR versus no treatment was $0.01 per DALY averted (indicating marginal cost savings with health gains), well below Jamaica's cost-effectiveness threshold.

Sensitivity Analyses

One-Way Sensitivity Analysis

Tornado diagram analysis (Figure 2) revealed that model results were most sensitive to the cost of RADTs, followed by the risk of death with RF-associated events and incidence of pharyngitis. The 95% credibility intervals affected the ICER by a maximum of 0.0022 (cost of RADTs: 0.0052 - 0.0074, RF risk of death: 0.0034 - 0.0057, and incidence of pharyngitis 0.0034 - 0.0057).

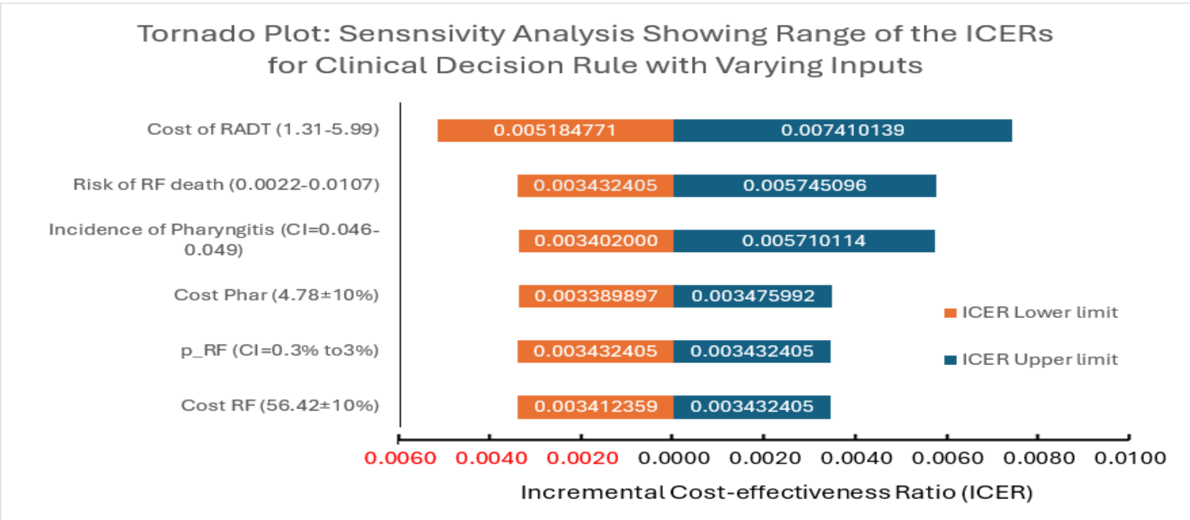

Figure 2: Tornado Plot of Deterministic Sensitivity Analysis presenting uncertainty of the ICER for CDR Intervention in managing Sore throat, Jamaica, 2018

Multivariate Sensitivity Analysis

Even at the extremes of plausible parameter ranges, the CDR strategy remained cost saving in 99% of scenarios (See Figure 3).

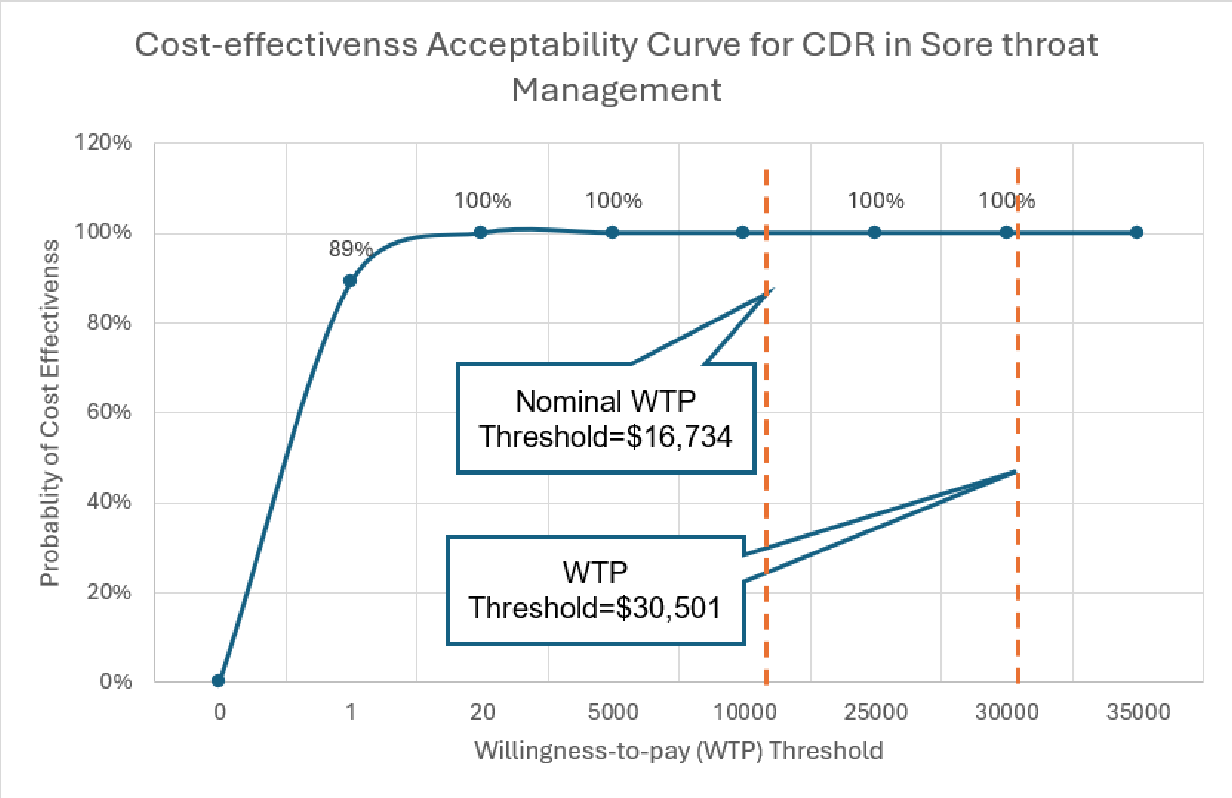

Figure 3:Cost-effectiveness Acceptability Curve for CDR in Sore Throat Management

Shows the probability that the CDR is cost-effective (compared to Current and No treatment) across both nominal and (adjusted) willingness-to-pay thresholds. The Nominal WTP used here is three times the Nominal GDP ($5,574), while $30,501 represents three times the adjusted GDP ($10,167)

Affordability Analysis

The incremental cost of CDR implementation per pharyngitis episode was estimated at $8.50, comprising $4.50 for RADT (adjusted for importation, inflation, wastage, etc), $2.00 for CDR training and materials, and $2.00 for quality assurance and monitoring. At Jamaica's 2018 minimum weekly wage of $7,000 JMD ($54.30 USD), the intervention represents only 15.7% of weekly income, well within the affordability threshold for essential health services. Nationwide implementation for an estimated 30,000 annual pharyngitis episodes for children 0-15 would require initial capital investment of approximately $152,000 for training, protocol development, and initial RADT procurement, with annual recurrent costs of $135,000. This represents less than 0.1% of Jamaica's annual health budget.

DISCUSSION

Principal Findings

This study demonstrates that implementing clinical decision rules with rapid antigen detection test support for pharyngitis management in Jamaica would be cost-saving ($21.83 per person) and somewhat clinically superior (0.14 DALYs averted) to current practice. The CDR strategy dominated all alternatives, providing better health outcomes at lower lifetime costs. The model was robust across a wide range (99%) of scenarios (Figures 3 and 4) and support WHO recommendations for improved diagnostic approaches in RF and RHD prevention programmes.

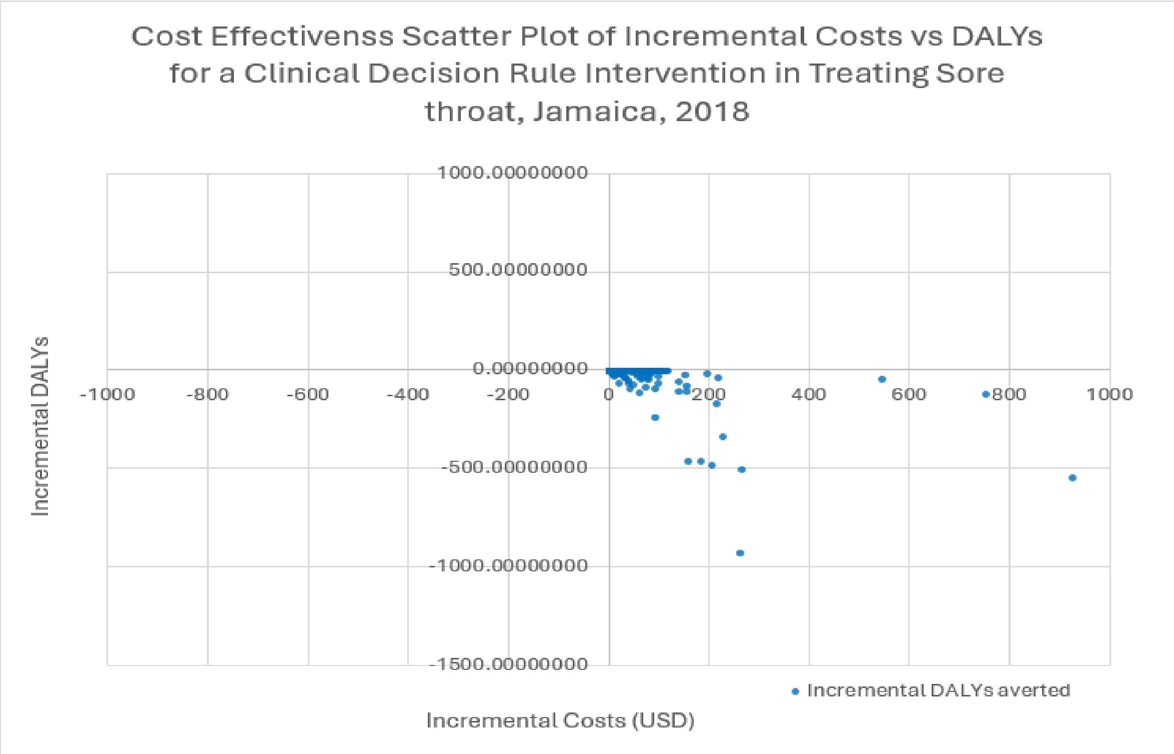

Figure 4: Cost Effectiveness Scatter Plot of Incremental Costs vs Incremental DALYs For a clinical Decision Rule Intervention in treating Sore Throat, Jamaica, 2018

Compared to the current scenario, the CDR I more effective and less costly, evidenced by the DALYs averted falling in the South-East (lower right) quadrant). Hence the CDR is considered "dominant".

Comparison with Other Studies

Our findings align with economic evaluations from other settings, though direct comparisons are limited by different healthcare contexts and model structures.

A systematic literature review by Lee et al concluded that there were limited number of CEA studies on Strep A, and also highlighted the development of ARF and RHD from non-sore throat strep infections, and the consideration of a Strep A vaccine for primordial prevention of Rheumatic sequalae (12).

Cuba achieved a 10-fold decrease in the prevalence of RHD in school children (2.27 to 0.24 per 1000) over a ten year period (1986 to 1996), primarily using a 'Treat all" approach (13). This was incredibly cost effective as a retrospective analysis by Watkins calculated that 5051 DALYs were averted (1844 per 100,000 school-aged children) and saved $7,848,590 (2010 USD) for a programme that cost only $202,890 over 10 years (14).

Irlam et al's 2013 study in urban primary care clinics in South Africa demonstrated that a treat all approach was least costly at $11.19 per child, followed by varying combinations of CDR cutoffs and bacterial culturing. The preferred strategy of using a CDR score of >2 plus culture positive CDR<2 cases cost below $150/QALY (15).

Little et al justified the use of delaying antibiotic use until reassessment, citing the inefficiencies and cost of RADTs as adding only some advantage over clinical scoring alone (5). However, Seeley criticizes Little's CDR for insufficient external validation (16), a point worth, considering for similar future local studies.

Notable differences exist between high and low-income country analyses, including the stakes of missed GAS diagnosis and management, lack of secondary prevention support, and reduced availability and sustainability of interventions against RF sequalae in the latter (17). This is especially true in resource-limited settings, where downstream RF and RHD complications are frequent enough to overwhelm systems, but are not enough to justify funding associated with academic grants or LMIC status, as in the case of Jamaica.

Policy Implications

These findings have important implications for Jamaica's national RF and RHD control programme and potentially for similar programmes in other Caribbean and Latin American nations. The analysis provides economic justification for Ministry of Health investment in:

1. Procurement and distribution of RADTs to primary care facilities, particularly in high-prevalence areas.
2. Development and dissemination of standardized clinical decision protocols for pharyngitis assessment.
3. Training programmes for primary care providers in CDR application and RADT interpretation.
4. Quality assurance mechanisms to ensure appropriate test utilization and adherence to treatment algorithms.

The intervention's dominance (cost-saving with better outcomes) strengthens the case for implementation, as it addresses both health improvement and healthcare budget constraints simultaneously. This is particularly relevant in the international context of Universal Health Coverage goals and Sustainable Development Goal 3 (ensure healthy lives and promote well-being for all), and the Jamaica-specific context of no user fees in public health care.

Antimicrobial stewardship

These findings also support antimicrobial stewardship (AMS) through more judicial use of antibiotics via a CDR compared to the treat all or current scenarios. A 2023 Systemic review by Jane et al across 19 countries revealed that 50% of patients receiving antibiotics for sore throat were either GAS-negative or not tested (18). Furthermore, a 2025 Jamaican study highlighted that antibiotics were indicated in only 22.3%, but used in 91% of patients presenting for sore throat (19). The use of validated clinical decision rules with or without biochemical confirmation of target bacteria are globally advocated to reduce antibiotic misuse/overuse (20,21,22) and maintain physician satisfaction (23).

AMS is important in the fight against antimicrobial resistance which continues to pose a growing and complex threat to public health, food security, and economic stability across the world including in the Caribbean, particularly within LMICs (24,25). This highlights the importance of having an intervention that is not only cost effective but also have added advantage of preserving the utility of this critical therapy.

Implementation Considerations

Successful implementation will require attention to several practical considerations:

Healthcare Provider Training: Comprehensive training on CDR application, proper throat swab technique, RADT performance and interpretation, and adherence to treatment algorithms. Training should emphasize both clinical skills and antibiotic stewardship principles.

Supply Chain Management: Reliable RADT supply requires robust procurement systems, appropriate storage conditions (some tests require refrigeration), and inventory management to prevent stockouts. Integration with existing pharmaceutical and laboratory supply chains may offer efficiencies.

Quality Assurance: Regular proficiency testing, periodic sensitivity analysis of RADT performance in local context, and monitoring of adherence to protocols through clinical audits.

Patient Communication: Public education regarding appropriate antibiotic use, and explanation of testing rationale to patients and caregivers.

Resistance to change

Initial resistance may emerge within clinician and patient domains due to reassurance and expectations grounded in the immediate use of antibiotics for sore throats. Training should include culturally-specific testimonials and psychologically-grounded change management interventions.

Equity Considerations

RF and RHD disproportionately affects disadvantaged populations with limited healthcare access, poor housing conditions, and delayed care-seeking. Jamaica has robust health system access, availability and provision of medications. This is further strengthened by the National Health Fund which substantially bolters procurement of essential and necessary drugs. CDR implementation offers potential equity benefits by driving the Ministry of Health and Wellness to standardize protocols and reinforce appropriate use of antibiotics.

Improving diagnostic accuracy across all socioeconomic groups may be an additional benefit. However, diagnostic approaches were determined to be similar across private and public health practitioners (7), with almost unanimous request for a national protocol by local practitioners. Standardized protocols may particularly benefit patients in facilities where clinical expertise varies based on exposure and experience.

However, equity in access to the CDR/RADT intervention must be carefully monitored. Implementation should prioritize high-burden communities and public facilities serving vulnerable populations. The relatively low cost per episode ($8.50) and overall budget impact suggest the intervention is feasible for universal coverage within the public system.

Strengths and Limitations

This study's strengths include the use of local Jamaican cost and epidemiological data, comprehensive modelling of lifetime costs and outcomes, rigorous sensitivity analyses demonstrating result robustness, and direct relevance to current policy discussions.

Our findings may be generalizable to other Caribbean nations and LMICs with similar RF/RHD burden, healthcare infrastructure, and GAS epidemiology. Countries with active RF/RHD control programmes, school-aged populations at risk, and primary care-based pharyngitis management represent the most appropriate contexts for CDR/RADT implementation.

Several limitations merit consideration. Pharyngitis incidence calculations relied on medical record review and insurance claims, which were both limited to cases that were appropriately diagnosed, recorded and reported. While the primary sheets from public sites provided enough information to differentiate between new and review cases, reports from insurance companies were counted as discrete cases even if one patient had more than one review for the same event. Furthermore, insurance company reports did not segregate cases by age, necessitating an estimated age-specific incidence. These limitations, in addition to self-medication and care-seeking outside captured facilities, potentially underestimate true incidence. Direct population surveillance would provide more accurate estimates but was beyond study scope.

Cost data derived from fee schedules rather than micro-costing may not fully capture actual resource utilization. However, fee schedules represent the best available proxy for healthcare system costs and facilitate comparison with budget allocation decisions. Furthermore, patients had to be placed in costing designations based on the management approach, negating the overlap of both RF-associated events and hospital visits in weighted cost calculations.

The model assumed consistent adherence to CDR protocols and RADT interpretation, which may not reflect real-world practice variability. Implementation research will be necessary to assess actual performance and identify strategies to maximize protocol adherence.

We did not incorporate indirect costs, including productivity losses, caregiver burden, transportation costs, or other societal costs. From this perspective, the CDR strategy's dominance would likely be more pronounced given fewer burden from complications and hospital visits.

Parameter uncertainty exists around ARF development risk, RHD progression rates, and long-term outcomes in the Jamaican context. While we used best available evidence from similar populations, local epidemiological studies would strengthen parameter estimates. The PSA addressed this uncertainty, with results remaining robust.

CONCLUSION

This economic evaluation demonstrates that implementing clinical decision rules with rapid antigen detection test support for pharyngitis management in Jamaica would simultaneously improve health outcomes and reduce healthcare costs compared to current empirical practice. The intervention's dominance across sensitivity analyses, coupled with minimal budget impact and alignment with international recommendations, provides compelling evidence for policy action.

Jamaica's longstanding commitment to RF and RHD prevention through its national control programme positions it well for CDR/RADT implementation. The estimated $152,000 initial investment and $135,000 annual recurrent cost represent modest expenditures given the potential for improved population health outcomes and healthcare system savings.

Beyond Jamaica, these findings contribute to the growing evidence base supporting WHO recommendations for improved diagnostic approaches in RF and RHD prevention. As LMICs worldwide grapple with balancing antibiotic stewardship against prevention of severe bacterial complications, this study offers actionable evidence for evidence-based policy making in resource-limited settings.

Disclosure

Any use of generative AI in this manuscript adheres to ethical guidelines for use and acknowledgment of Generative AI in academic research. Each author has made substantial contribution to the work, which has been thoroughly vetted for accuracy, and assumes responsibility for the integrity of the contributions. Generative AI was exclusively used for improving clarity and summarizing content.

Authors' Contributions

YR conceived the study, conducted data collection, performed the economic analysis, and drafted the manuscript. CATR contributed to study design, data collection, and critical revision of the manuscript. JPF provided clinical expertise, contributed to study design, and critically revised the manuscript. All authors approved the final version.

Data Availability

Deidentified data supporting the findings of this study are available from the corresponding author upon reasonable request. Model structure and parameters are fully described in the methods section and supplementary materials.

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