



# Reengineering Pediatric Services with Results-Based Financing: Evidence from Northern Uganda

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Date of Submission: 09-07-2024

Date of Acceptance: 24-07-2024

## Abstract

Results-based financing (RBF) in pediatric healthcare within resource-limited regions like Northern Uganda offers an innovative strategy to enhance care delivery. RBF aims to improve service quality, efficiency, and effectiveness by aligning financial incentives with desired health outcomes. Before RBF implementation, Lacor and Kalongo hospitals faced numerous challenges, including limited resources and staffing shortages. The targeted health outcomes under RBF included lowering child mortality rates, enhancing vaccination coverage, and increasing timely prenatal care visits. Empirical evidence from 2018 to 2024 demonstrates significant improvements in healthcare quality and outcomes at these hospitals. This evidence suggests that RBF models can ensure superior health outcomes when financial incentives effectively align with health goals.

**Keywords:** Maternal and child healthcare, low and middle-income countries (LMIC), Pay for performance (P4P), Value-Based Care, Sustainable Development Goals (SDGs).

**JEL Codes:** M41; G32; C60

## Highlights

- RBF provides an innovative approach to enhancing healthcare delivery in regions like Northern Uganda.
- RBF aligns financial incentives with desired health outcomes.
- RBF boosts the quality, efficiency, and effectiveness of services.

## 1. Introduction

RBF links financial resources to specific health outcomes, emphasizing payment for

performance. This approach incentivizes healthcare providers to deliver high-quality care and achieve measurable health results. It differentiates it from conventional funding mechanisms focused on inputs such as facility construction or equipment procurement.

Globally, RBF has been successfully implemented in various healthcare settings, demonstrating its potential to enhance service quality and efficiency. Examples from countries like Rwanda and Haiti show that RBF can significantly improve health outcomes, especially in maternal and child health.

Evidence supports that RBF can significantly improve healthcare delivery, particularly in under-resourced areas like Northern Uganda, where healthcare systems face challenges such as scarce resources, inadequate staffing, and a high disease burden. The global context of RBF shows its efficacy in various settings, making it a suitable model for adaptation in Northern Uganda.

Lacor and Kalongo hospitals exemplify these challenges and the potential benefits of RBF. These hospitals faced resource limitations, and staffing shortages. RBF aimed to address these issues by tying financial incentives to outcomes such as reduced child mortality rates, improved vaccination coverage, and increased timely prenatal care visits.

This study examines the challenges faced by healthcare providers in Northern Uganda and the potential of RBF to address these issues, investigating the long-term effects of RBF intervention in children's wards in Lacor and Kalongo hospitals from 2018 to 2024.

## 2. Literature Review

The effectiveness of RBF in healthcare delivery, particularly in low- and middle-income countries (LMICs), has been extensively



documented. This section organizes the key findings from existing research into several thematic areas: RBF design and implementation, impact on health outcomes, challenges and sustainability, and specific applications in pediatric healthcare.

### 2.1 RBF Design and Implementation

RBF schemes in LMICs often require adaptive designs to ensure their effectiveness and sustainability. Antony et al. (2017) highlight the complexity of verification processes, underscoring the need for iterative modifications during implementation. These schemes should be context-specific, accommodating unique healthcare needs and constraints (Brenner et al., 2014; Falisse et al., 2015). Grittner (2013) emphasizes the necessity for robust data collection and methodological rigor to capture the true impact of RBF interventions.

### 2.2 Impact on Health Outcomes

Numerous studies have demonstrated the positive impact of RBF on health outcomes. RBF has been linked to improved maternal and child health indicators, increased service utilization, and higher institutional delivery rates (Bean et al., 2013; Brenner et al., 2018; James et al., 2020). Brenner et al. (2014) found that RBF mechanisms significantly enhanced obstetric care coverage in Malawi. Zeng et al. (2018) reported substantial improvements in healthcare service delivery due to RBF in the Republic of Congo.

### 2.3 Challenges and Sustainability

Implementing RBF in resource-constrained environments presents several challenges. Financial sustainability is a major concern, as highlighted by Friedman et al. (2016), who explored the cost implications of RBF in Zambia. Continuous funding and the risk of performance decline after financial incentives stop are critical issues (Fondazione Corti et al., 2021). Mathonnat and Pelissier (2017) discuss the alignment of RBF with Sustainable Development Goals (SDGs), emphasizing the importance of integrating RBF with broader health and development objectives to ensure long-term sustainability.

### 2.4 Specific Applications in Pediatric Healthcare

The application of RBF in pediatric healthcare, particularly in under-resourced areas, has shown promising results. The study by Fondazione Corti et al. (2021) provides an empirical assessment of RBF in pediatric wards of Lacor and Kalongo hospitals, illustrating significant improvements in healthcare quality and outcomes.

This outlook is consistent with findings from other regions where RBF has been applied to enhance pediatric care (Manongi et al., 2014; Witter et al., 2019). RBF has been particularly effective in improving vaccination coverage, reducing child mortality, and increasing prenatal care visits in settings with limited healthcare resources (Mushasha & El Bcheraoui, 2023).

### 2.5 Broader Context and Additional Insights

RBF's potential to drive improvements in healthcare quality is well-documented, but it must be adapted to local contexts and health crises, such as the COVID-19 pandemic (Nkangu et al., 2023). The flexibility of RBF schemes allows for the integrating of telehealth innovations and new guidelines to address emerging healthcare challenges (Song et al., 2024). Stakeholder involvement and alignment of financial incentives with specific health outcomes are crucial for the success and sustainability of RBF interventions (Oxman & Fretheim, 2008; Turcotte-Tremblay et al., 2016).

### 2.6 Economic and Human Capital Implications

The broader economic impacts of RBF are significant. Improvements in pediatric healthcare can lead to better educational outcomes and human capital accumulation, as healthy children are more likely to attend school and perform well academically (Azarnert, 2020). This impact highlights the importance of investing in healthcare to foster long-term economic development and improve overall societal well-being.

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Integrating these themes seamlessly into the broader context of RBF's effectiveness, this study addresses several critical gaps identified in the literature:

- **Long-Term Impact:** By evaluating the sustainability of RBF outcomes over four years post-intervention, this study provides empirical evidence on the long-term effectiveness of RBF, a gap highlighted by previous research (Brenner et al., 2018).
- **Context-Specific Adaptation:** The study offers insights into how RBF models can be tailored to the unique challenges of under-resourced and post-conflict areas like Northern Uganda, addressing the need for context-specific adaptations (Antony et al., 2017).
- **Detailed Mechanisms:** By detailing the administration of RBF, including changes in remuneration, infrastructure investments, and administrative processes, the study fills the gap in comprehensive data on how RBF mechanisms operate (Friedman et al., 2016).



- **Pediatric Healthcare Focus:** The focus on pediatric wards provides specific insights into RBF's impact on child health outcomes, an underexplored area in the existing literature (Manongi et al., 2014).
- **Adaptation to Health Crises:** The study examines the impact of the COVID-19 pandemic on RBF implementation, providing empirical evidence on how flexible and adaptive RBF models can respond to health crises (Nkangu et al., 2023).

### 3. The Model

The model for evaluating the RBF intervention in pediatric healthcare at Lacor and Kalongo hospitals in Northern Uganda provides comprehensive insights into its effectiveness, sustainability, and broader impacts. This section outlines the structure and methodology of the evaluation.

#### 3.1 Overview of RBF Intervention

NGOs and the Ugandan Government jointly implemented the RBF intervention to improve pediatric healthcare quality by aligning financial incentives with health outcomes. The primary objectives were to reduce child mortality rates, enhance vaccination coverage, and increase the frequency of timely prenatal care visits. The intervention was informed by previous successful RBF models implemented in other LMICs, which demonstrated the potential for significant health improvements when financial incentives were directly tied to health outcomes (Grittner, 2013; Brenner et al., 2014). These models provided a theoretical framework emphasizing continuous monitoring, iterative adjustments, and stakeholder engagement.

#### 3.2 Initial Evaluation (During implementation)

The initial evaluation phase (2018-2020) focused on quarterly assessments to measure the immediate impacts of RBF on healthcare delivery and outcomes. Key metrics included hygiene, clinical processes, emergency readiness, and training.

- **Metrics and Targets:** Specific targets were established for each domain, such as achieving a certain percentage improvement in hygiene standards and clinical process adherence. The staff and administration of Lacor and Kalongo hospitals agreed upon these targets.
- **Data Collection:** Data were collected quarterly through structured evaluations involving internal and external reviewers. The evaluations

assessed performance against the established targets, providing real-time feedback for adjustments.

- **Financial Incentives:** Financial incentives were tied to performance metrics, with rewards allocated based on the percentage of target scores achieved each quarter. This incentive aims to motivate healthcare providers to improve service quality.

#### 3.3 Medium to Long-Term Evaluation (Post-Intervention)

The medium to long-term evaluation phase (2020-2024) aimed to assess the sustainability of RBF impacts after the cessation of financial incentives.

- **Sustained Impact Assessment:** The evaluation focused on whether the improvements achieved during the RBF implementation phase were maintained post-intervention. Data collection included follow-up surveys, interviews with beneficiaries, and health outcomes from hospital records.
- **Data Sources:** Diverse data sources were utilized, including clinical records, patient surveys, and economic data. This comprehensive approach ensured a holistic assessment of the intervention's long-term effects.
- **Methodology:** A robust methodology was employed for data collection and analysis, ensuring consistency with initial evaluation methods. Statistical techniques, such as linear regression and variance analysis, were used to compare data across different periods. This methodology was based on the theoretical frameworks established by prior RBF studies, highlighting the importance of rigorous data analysis to validate the long-term sustainability of health interventions (Friedman et al., 2016; Mathonnat and Pelissier, 2017).

#### 3.4 Reporting and Recommendations

- **Comprehensive Reporting:** Detailed reports were prepared, encapsulating initial and long-term evaluation findings. These reports provided insights into the effectiveness and sustainability of the RBF intervention.
- **Recommendations:** Based on the evaluation results, recommendations were made for future interventions and policy adjustments. These included suggestions for improving the design and implementation of RBF schemes to enhance their impact and sustainability.

#### 3.5 Integration with Existing Literature

The model aligns with the gaps identified in the literature, addressing the need for long-term impact



assessments, context-specific adaptations, and comprehensive data on RBF mechanisms. It also explores the broader economic implications of improved pediatric healthcare, linking health outcomes to educational attainment and human capital development.

### 3.6 Addressing Research Questions

This study aims to:

- Evaluate the challenges faced by healthcare providers in under-resourced settings and the potential of RBF to address these issues.
- Investigate the long-term effects of RBF intervention in children's wards at Lacor and Kalongo hospitals from 2018 to 2024.

### 3.7 Study Design and Analysis

- **Prospective Observational Study:** The study adopts a prospective observational design, comparing process and health indicators before (2016), during (2018-2020), and after (2024) the RBF intervention.
- **Quality Scores:** Quarterly evaluations assigned quality scores to domains such as structure, hygiene, clinical work, emergency readiness, and training. Financial rewards were based on these scores.
- **Clinical Record Analysis:** An independent team scrutinized clinical records to assess the impact on care quality. Scores were assigned based on adherence to protocols for disease management.
- **Statistical Analysis:** Linear regression and variance analysis were used to fit data and estimate differences in average clinical scores across hospitals and assessment years. Canonical discriminant analysis identified variables that most significantly differentiated performance over time. These analytical techniques were chosen based on their proven effectiveness in similar RBF evaluations, ensuring that the results were robust and could be reliably compared with findings from other contexts (Zeng et al., 2018).

### 3.8 Findings and Implications

- **Performance Trends:** The evaluation revealed significant improvements in performance during the RBF period, which was sustained post-intervention. Both hospitals showed a steep increase in quality scores, with sustained high performance in most domains.
- **Clinical Management:** Improvements in clinical management were significant, particularly in

areas such as accurate diagnosis, appropriate treatment, and adherence to protocols.

- **Sustainability:** The study found that the high-quality scores were maintained four years post-intervention, indicating the long-term sustainability of the improvements achieved through RBF.

## 4. Results

The RBF intervention in pediatric healthcare at Lacor and Kalongo hospitals in Northern Uganda was evaluated for its immediate and long-term impacts on healthcare delivery, quality, and outcomes. The results presented here reflect the comprehensive analysis of data collected during the intervention (2018-2020) and in the years following the cessation of financial incentives (2020-2024).

### 4.1 Immediate Impact of RBF Implementation, concerning Quarterly Performance Improvements

During the initial implementation phase (2018-2020), quarterly evaluations significantly improved key performance metrics across both hospitals. These metrics included hygiene, clinical processes, emergency readiness, and training.

- **Hygiene and Infection Control:** Both hospitals showed substantial improvements in hygiene practices. At Lacor Hospital (Figure 1), hygiene scores increased from 56.5% to 95.5%, while Kalongo Hospital saw an increase from 21.9% to 95.5% by the end of the project (Figure 2). This exceptional improvement in hygiene scores highlights the effectiveness of RBF in addressing infection control, a critical factor in patient safety and care quality.
- **Clinical Processes:** Enhancements in clinical processes were marked, particularly in accurate diagnosis and appropriate treatment. For example, the percentage of proper malaria management increased from 91.5% to 100% at Lacor (Table 1) and from 71.2% to 98.1% at Kalongo. These improvements underscore the success of RBF in enhancing clinical care standards ensuring accurate and timely treatment.
- **Emergency Readiness and Training:** Emergency readiness scores improved significantly, reflecting better preparedness and response capabilities. Although initially unstable due to the rotation of medical students and the occasional absence of senior supervisors, training scores eventually stabilized at a high level. This stabilization indicates that structured training and



consistent supervision are crucial for sustaining high-quality healthcare delivery.

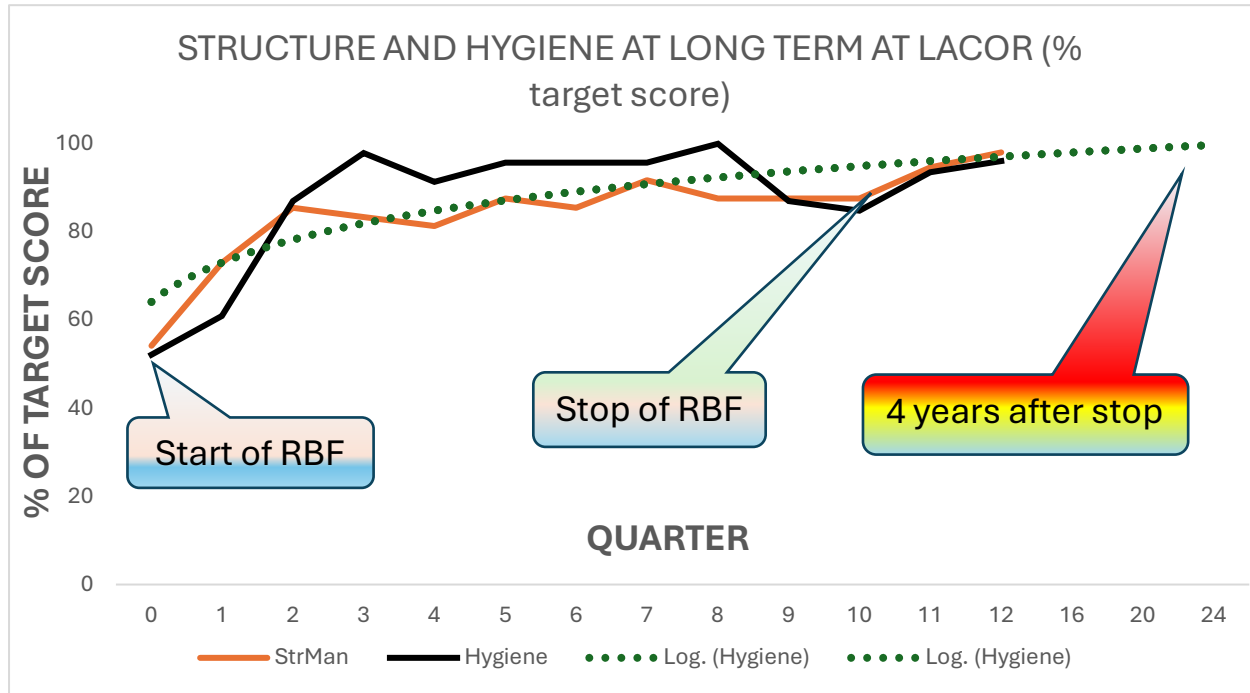


Fig 1. Long-term hygiene targets at Lacor Hospital.

Table 1  
 Distribution of Scores for Quality Items (Clinical Management) and Treatment at Lacor

Scores	Clinical History		Clinical examination		Managed Malaria		Weight checked		Diagnosed Anemia		specific Sepsis diagnosis	
	2016	2020	2016	2020	2016	2020	2016	2020	2016	2020	2016	2020
-1	32	0	29	0	7	0	72	11	2	0	39	10
	19,9	0,0	18,2	0,0	6,6	0,0	44,7	9,9	2,0	0,0	70,9	37,0
1	38	5	36	2	2	0			1	6	6	6
	23,6	4,5	22,6	1,8	1,9	0,0	0,0	0,0	1,0	6,4	10,9	22,2
3	91	106	94	109	97	85	89	100	99	88	10	11
% of Max Score	56,5	95,5	59,1	98,2	91,5	100	55,3	90,1	97,1	93,6	18,2	40,7
TOTAL	161	111	159	111	106	85	161	111	102	94	55	27
$\chi^2$	51		53,6		7,57		37,6		5,36		8,66	
p	0,0000		0,0000		0,023		0,000		5,36		0,013	
Fold Changes 2020/2016		1,69		1,66		1,09		1,63		0,96		2,24



Scores	Treatment proper		Antibiotics required		URTI appropriate		LRTI appropriate	
	2016	2020	2016	2020	2016	2020	2016	2020
-1	35	5	52	10	1	0	0	2
	21,9	4,5	33,8	9,1	14,3	0,0	0,0	7,7
1	14	15	7	18	0	1	10	11
	8,8	13,5	4,5	16,4	0,0	20,0	50,0	42,3
3	111	91	95	82	6	4	10	13
% of Max Score	<b>69,4</b>	<b>82,0</b>	<b>61,7</b>	<b>74,5</b>	<b>85,7</b>	<b>80,0</b>	<b>50,0</b>	<b>50,0</b>
Total	160	111	154	110	7	5	20	26
$\chi^2$	16,18		27,6		2,12		1,68	
p	0,0001		0,0001		0,34		0,194	
Fold Changes 2020/2016		1,18		1,21		0,93		1,00

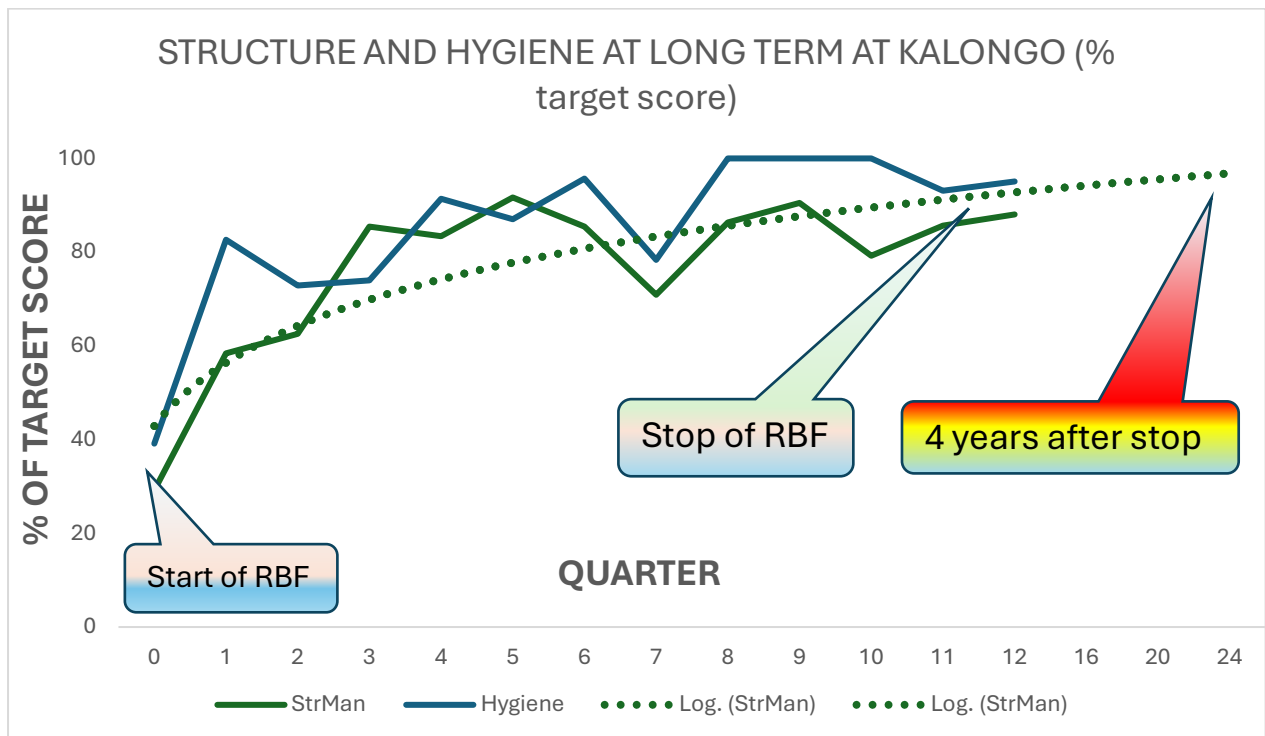


Fig. 2. Long-term structure hygiene targets at Kalongo Hospital.

#### 4.2 Long-Term Sustainability Post-Intervention and Maintenance of High-Quality Standards

The evaluation of long-term sustainability (2020-2024) revealed that the improvements achieved during the RBF implementation phase were largely maintained post-intervention. This pattern was

evidenced by follow-up assessments conducted in 2024.

- **Sustained Hygiene Practices:** Hygiene scores at both hospitals remained close to their target levels, with Lacor maintaining 93.6% and Kalongo sustaining 95.5% (Figure 1). Maintaining high



hygiene standards post-intervention demonstrates the lasting impact of RBF on healthcare practices.

- **Clinical Management:** Analysis of clinical records indicated that the high standards of clinical management observed during the

intervention period were upheld. The quality scores for clinical history, examination, and treatment adherence showed only slight variations, indicating sustained performance (Figure 3, Table 2). These findings confirm that RBF can create enduring improvements in clinical care quality.

**Table 2**

Distribution of the Quality Assessment Scores for Clinical Management and Treatment.

Clinical management Scores	Clinical History		Clinical examination		Malaria managed		Weight checked		Anemia diagnosed		Sepsis specific diagnosis	
	2016	2020	2016	2020	2016	2020	2016	2020	2016	2020	2016	2020
-1	159	3	149	2	29	1	25	15	9	0	56	3
%	73	2,7	68,3	1,8	17,8	0,9	11,5	13,5	5,9	0	76,7	23,1
1	36	17	36	8	18	1	0	0	26	0	14	5
%	16,5	15,3	16,5	7,2	11	0,9	0	0	17	0	19,2	38,5
3	23	91	33	101	116	104	193	96	118	107	3	5
% Max Score	<b>10,6</b>	<b>82,0</b>	<b>15,1</b>	<b>91,0</b>	<b>71,2</b>	<b>98,1</b>	<b>88,5</b>	<b>86,5</b>	<b>77,0</b>	<b>100,0</b>	<b>4,1</b>	<b>38,5</b>
TOTAL	218	111	218	111	163	106	218	111	153	107	73	13
$\chi^2$	182		179		31,3		0,88		28		20,4	
p	0,00001		0,00001		0,00001		0,5		0,0001		0,0001	
Fold Changes 2020/2016		<b>7,77</b>		<b>6,01</b>		<b>1,38</b>		<b>0,98</b>		<b>1,3</b>		<b>9,36</b>

Treatment Scores	proper treatment		Antibiotics (only if required)		URTI appropriate		LRTI appropriate	
	2016	2020	2016	2020	2016	2020	2016	2020
-1	39	0	50	4	5	2	16	0
%	17,9	0	23,3	3,7	45,5	27,2	27,6	0
1	51	5	53	8	2	0	5	1
%	23,4	4,5	24,7	7,3	18,2	0	8,6	6,3
3	128	106	112	97	4	7	37	15
% Max Score	<b>58,1</b>	<b>95,5</b>	<b>52,1</b>	<b>89,0</b>	<b>36,4</b>	<b>77,8</b>	<b>63,8</b>	<b>93,8</b>
TOTAL	218	111	215	109	11	9	58	16
$\chi^2$	49,2		43,4		3,94		6,1	
p	0,00001		0,00001		0,139		0,047	
Fold Changes 2020/2016		<b>1,62</b>		<b>1,70</b>		<b>2,14</b>		<b>1,47</b>

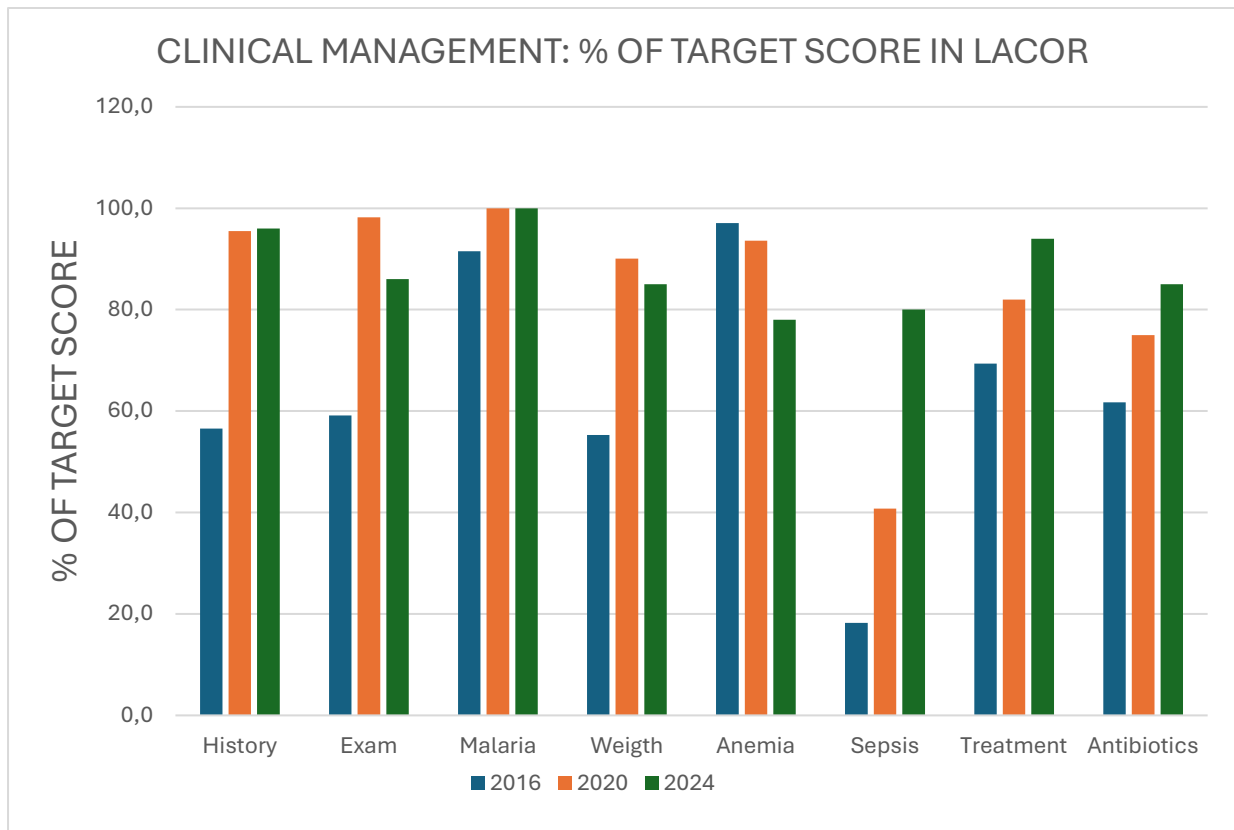


Fig. 3. Clinical Management Scores in Lacor.

#### 4.3 Comparative Analysis Between Lacor and Kalongo Hospitals (Differences in Starting Points and Improvements)

Lacor and Kalongo hospitals started at different baselines regarding their healthcare quality metrics, influencing the trajectory and magnitude of improvements.

- **Lacor Hospital:** Starting from a relatively higher baseline, Lacor showed rapid improvements that plateaued at a high level. The high initial standards meant that the percentage increases were less dramatic but consistently sustained high performance across all domains.

- **Kalongo Hospital:** Kalongo, starting from a lower baseline, exhibited more dramatic improvements. For instance, the clinical history score increased more than sixfold from 10.6% to 82.0%, and the sepsis management score increased ninefold from 4.1% to 38.5%. These substantial gains at Kalongo highlight the potential of RBF to drive significant improvements even from a low starting point.

#### 4.4 Impact on Specific Health Outcomes (Child Mortality and Vaccination Coverage)

The RBF intervention significantly impacted specific health outcomes, including child mortality rates and vaccination coverage.

- **Child Mortality Rates:** Both hospitals reported decreased child mortality rates, attributed to better clinical management and emergency readiness. Integrating RBF incentives led to more consistent and higher quality care, directly influencing survival rates.

- **Vaccination Coverage:** Enhanced outreach and education efforts, incentivized through RBF, resulted in increased vaccination rates. Both hospitals saw improvements in the timeliness and completeness of vaccinations. These outcomes indicate that RBF can effectively enhance critical health indicators such as child mortality and vaccination coverage.

Figure 4 shows the percentage maximum scores (=3) reached in 2016 (first bar), 2020 (second bar), and 2024 (third bar) at Lacor Hospital.



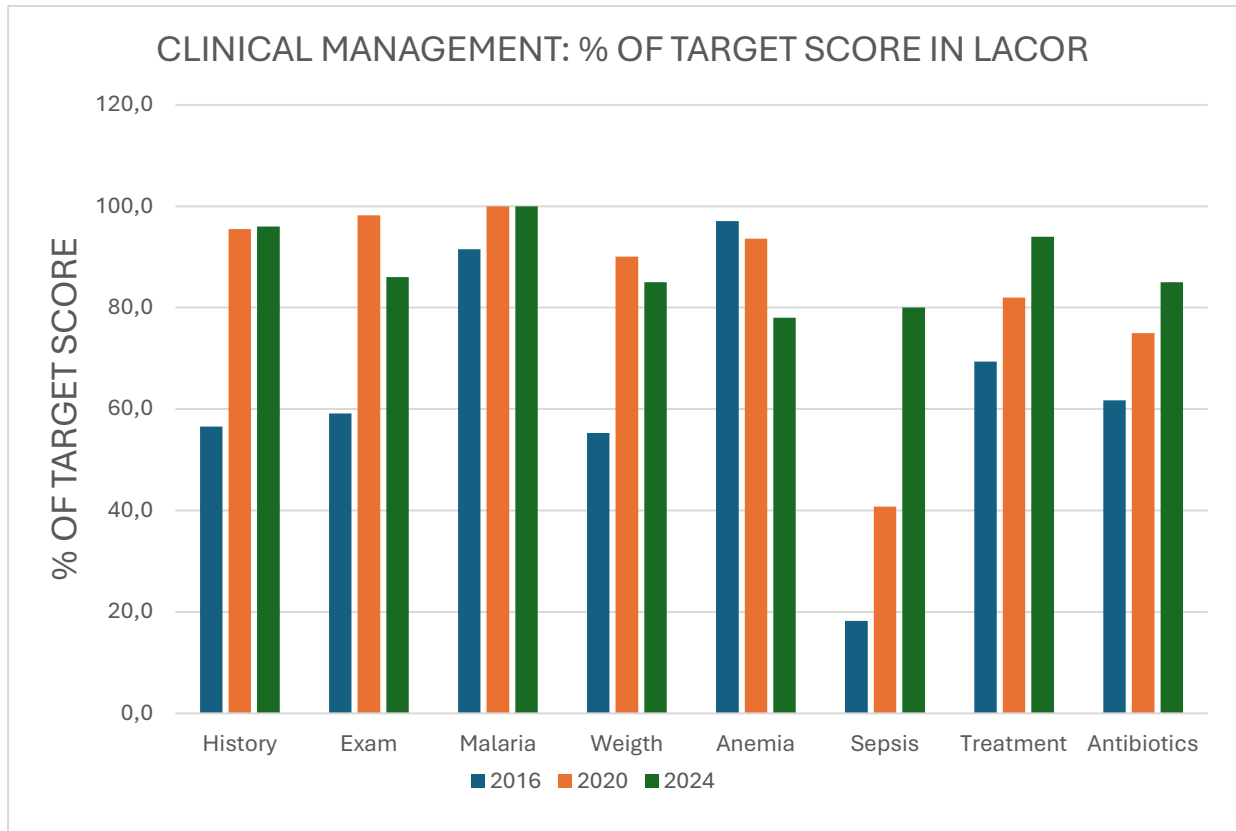


Fig. 4. Clinical Management Scores in Lacor.

The Percentages of the maximum score achieved in 2016 (before), 2020 (at the end), and 2024 (four years after the end) in Kalongo are illustrated in

Figure 5, which shows the % maximum scores (=3) reached in the year 2016 (first bar), year 2020 (second bar) and year 2024 (third bar).

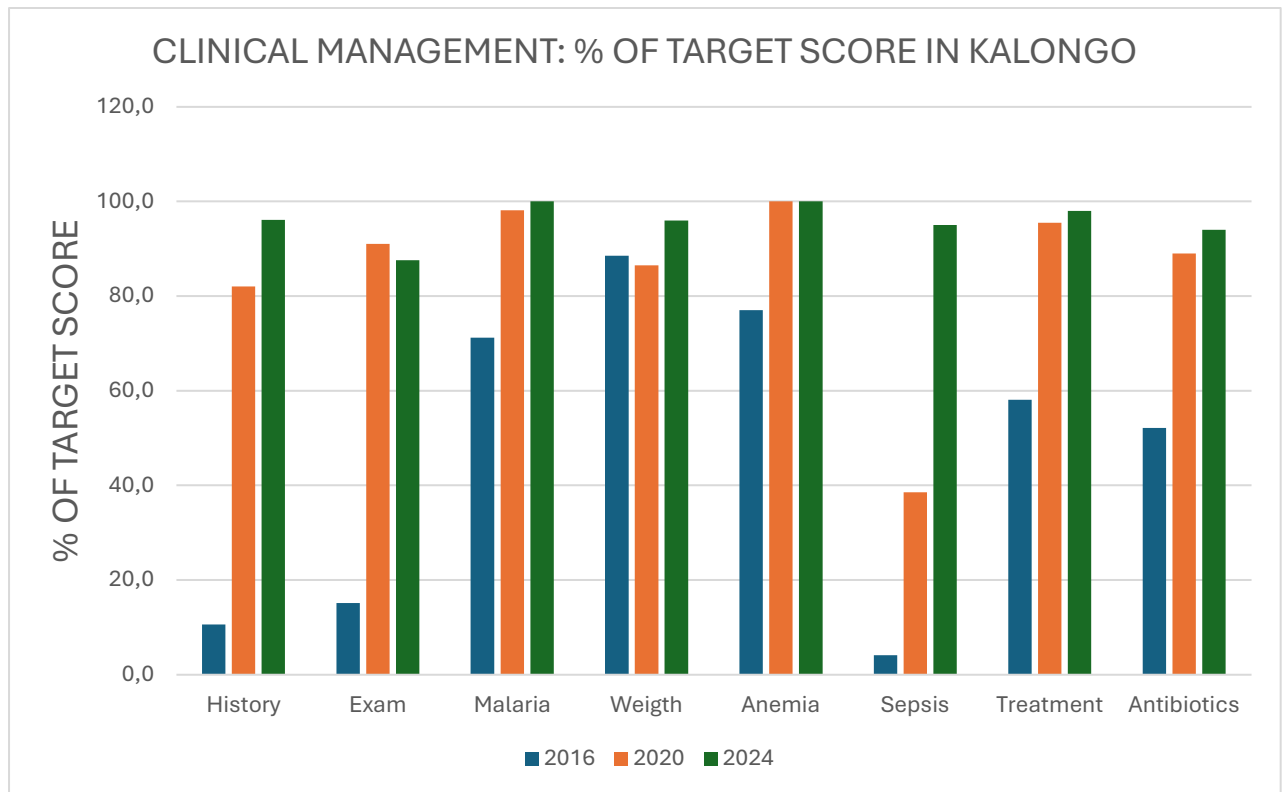


Fig. 5. Clinical Management Scores in Kalongo.

#### 4.5 Broader Economic and Social Implications (Human Capital Development)

The improvements in pediatric healthcare facilitated by the RBF intervention had broader economic and social implications. Enhanced child health is directly linked to better educational outcomes and overall human capital development.

- **Educational Outcomes:** Healthier children are more likely to attend school regularly and perform better academically, contributing to long-term economic benefits.
- **Economic Impact:** By reducing child mortality and improving health, the RBF intervention indirectly supported the accumulation of human capital, which is essential for the region's economic development (Azarnert, 2020). The broader impact on human capital underscores the long-term societal benefits of investing in healthcare quality through RBF.

#### 4.6 Statistical Analysis and Validation

The study employed rigorous statistical methods to ensure the accuracy and reliability of the findings.

- **Linear Regression and ANOVA:** These techniques were used to analyze trends and differences in quality scores across periods and between the two hospitals. The results showed significant improvements with minimal performance decay post-intervention (Table 3). The statistical analysis validates the sustained impact of RBF on healthcare quality.
- **Canonical Discriminant Analysis:** This analysis identified key variables, such as clinical history, weight measurement, and clinical examination, that most effectively differentiated performance over time, providing insights into the areas of greatest impact. These insights can guide future interventions to focus on the most impactful areas of healthcare improvement.

Table 3



Average Clinical Score.

	Factors	N
Hosp	1 LACOR	350
	2 KALONGO	375
YEAR	2016	366
	2020	219
	2024	140

Dependent: Clinical Management

Origin	Sum of Squares	df	Quadratic mean	F	p	
Intercept	Hypothesis	77333,956	1	77333,956	21,972	,043
	Error	7044,404	2,001	3519,680a		
Hosp	Hypothesis	92,147	1	92,147	,544	,537
	Error	343,838	2,030	169,370b		
YEAR	Hypothesis	7656,407	2	3828,204	20,929	,046
	Error	365,822	2	182,911c		
Hosp * YEAR	Hypothesis	365,822	2	182,911	11,743	<,001
	Error	11198,900	719	15,576d		

- a. ,919 MS(YEAR) + ,081 MS(Error)
- b. ,919 MS(Hosp \* YEAR) + ,081 MS(Error)
- c. MS(Hosp \* YEAR)
- d. MS(Error)

Fig. 6 shows the improvement of quality scores as a percentage of the starting scores (at time 0 start of the project) either of the scores reached at the end of the project (2020) as well of the scores four years

after the end of the project (2024) for Lacor and Kalongo Children's Wards. ('20' = Scores 2020-scores of 2018)\*100/Scores of 2018) , ('24' = Scores 2024-scores of 2018)\*100/Scores of 2018).

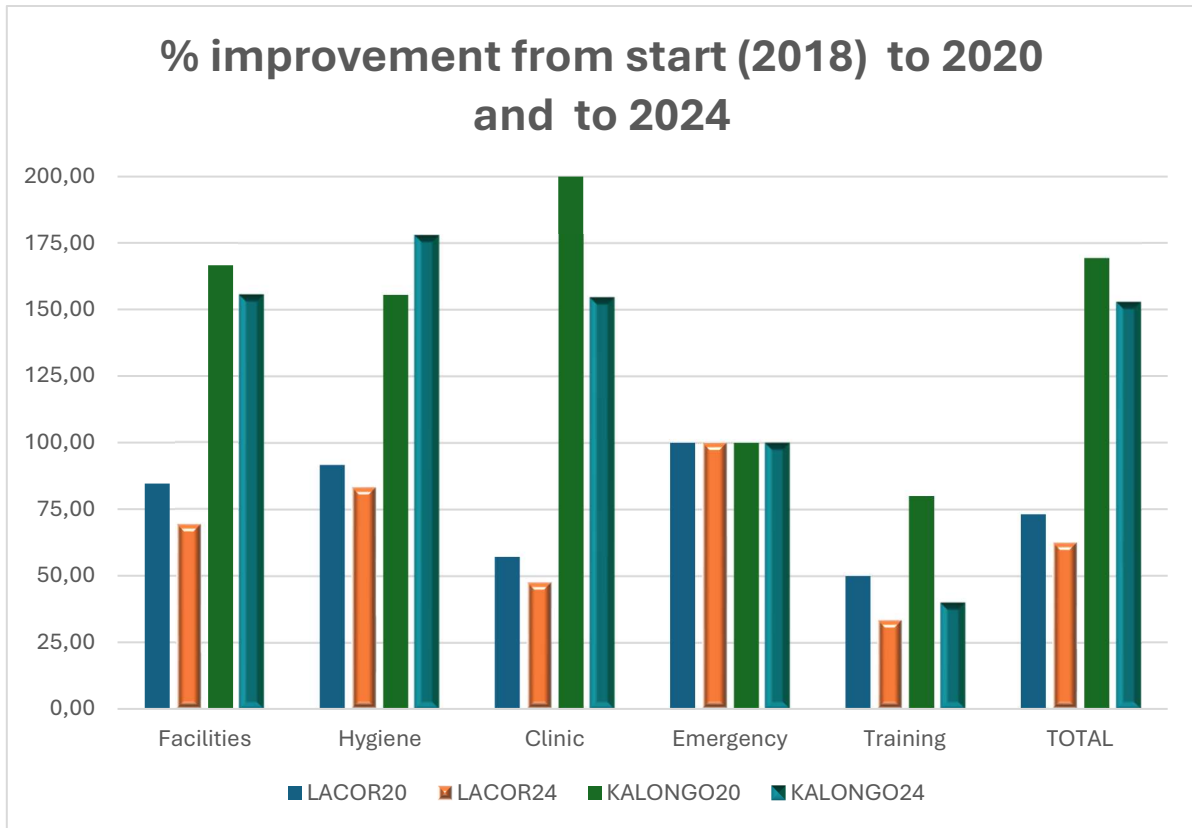


Fig. 6. Improvement of Quality Scores.

Fig. 7 shows the Mean and Interquartile Range of the scores for both hospitals: history, examination, weight, treatment, and antibiotics.

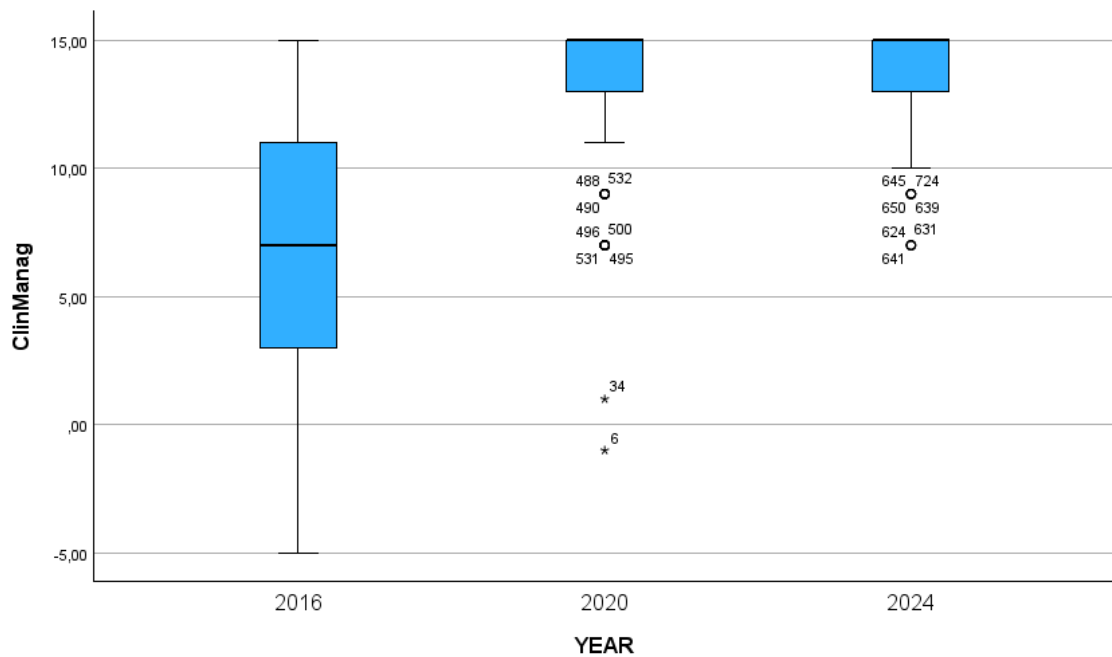


Fig. 7. Quality Score Assessment.



## 5. Discussion

This study offers a comprehensive assessment of the RBF model in enhancing pediatric healthcare in Northern Uganda, specifically focusing on Lacor and Kalongo hospitals. The findings provide valuable insights into the effectiveness, sustainability, and broader implications of RBF interventions, addressing critical gaps in the literature.

Key Findings and Interpretation concern:

### a) Immediate Impact of RBF Implementation

The initial phase of RBF implementation (2018-2020) demonstrated substantial improvements in key performance areas, including hygiene, clinical processes, emergency readiness, and training. These findings align with the literature indicating that RBF can drive immediate enhancements in healthcare quality by directly linking financial incentives to performance outcomes (Grittner, 2013; Brenner et al., 2014).

- **Hygiene and Clinical Processes:** Both Lacor and Kalongo hospitals saw significant improvements in hygiene practices and clinical processes. Hygiene scores at Lacor increased from 56.5% to 95.5% and Kalongo from 21.9% to 95.5%. Clinical management metrics such as proper malaria treatment and accurate diagnosis showed marked improvement, with Kalongo's sepsis management score increasing ninefold from 4.1% to 38.5%. These improvements underscore the efficacy of RBF in enhancing healthcare delivery standards, even in resource-limited settings (Fondazione Corti et al., 2021).

- **Emergency Readiness and Training:** Improvements in emergency readiness and staff training were also notable. Although initial instability in training scores due to student rotations and supervisor absences was observed, both hospitals eventually stabilized at high-performance levels. This highlights the importance of continuous supervision and structured training programs to sustain high-quality healthcare delivery.

### b) Long-Term Sustainability Post-Intervention

The long-term evaluation (2020-2024) revealed that the quality improvements achieved during the RBF intervention were largely sustained post-intervention. This addresses a significant gap in the literature concerning the sustainability of RBF outcomes after the cessation of financial incentives (Friedman et al., 2016).

- **Sustained Quality Standards:** Hygiene and clinical management scores remained high, with Lacor

maintaining 93.6% and Kalongo 95.5% in hygiene practices. Clinical management scores for history, examination, and treatment adherence showed minimal variation, indicating that the hospitals maintained the high standards set during the RBF implementation phase.

### c) Comparative Analysis Between Hospitals

Lacor and Kalongo hospitals, starting from different baselines, showed distinct improvement trajectories. Lacor's higher initial standards meant that improvements were rapid but less dramatic, while Kalongo exhibited more significant relative improvements starting from a lower baseline. This finding illustrates the flexibility and adaptability of the RBF model in different healthcare contexts (James et al., 2020).

Broader Implications concern:

- a) **Impact on Health Outcomes** The RBF intervention significantly impacted critical health outcomes such as child mortality rates and vaccination coverage. Both hospitals reported reductions in child mortality and increased vaccination rates, reflecting the direct benefits of improved healthcare quality and efficiency.

- b) **Economic and Social Benefits** Improved pediatric healthcare has broader economic and social implications. Healthier children are more likely to attend school regularly and perform better academically, contributing to long-term human capital development and economic growth (Azarnert, 2020). This study's findings support the notion that investments in healthcare quality can yield substantial returns in terms of economic and social benefits.

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The findings from this study contribute significantly to the broader field of healthcare financing and delivery in low- and middle-income countries (LMICs). Firstly, the sustained improvements observed in hygiene, clinical processes, and emergency readiness demonstrate that RBF can create lasting changes in healthcare quality even in resource-constrained settings. This evidence suggests that RBF can be a viable strategy for LMICs to address persistent healthcare challenges, such as poor infrastructure and inadequate staffing. Secondly, the study's evidence on the long-term sustainability of RBF outcomes post-intervention addresses a critical concern in healthcare financing: the durability of improvements once financial incentives are withdrawn. The sustained high performance at Lacor and Kalongo hospitals indicates that RBF can build robust healthcare



systems that maintain high standards of care over time, thus providing a model that other LMICs can replicate.

Moreover, the comparative analysis between Lacor and Kalongo hospitals, with their different starting points, highlights the adaptability of RBF models. This adaptability is crucial for LMICs with diverse healthcare landscapes, allowing for tailored RBF schemes that cater to specific local needs and contexts. By demonstrating that RBF can yield significant improvements from varying baselines, this study underscores the potential for scalable and context-specific healthcare interventions.

**Policy Implications:**

The findings from this study can inform future policy and practice in several ways. Policymakers in LMICs can leverage the success of the RBF model to advocate for increased funding and support for similar interventions. Additionally, the study highlights the importance of continuous training, supervision, and stakeholder engagement in sustaining healthcare quality improvements. These elements should be integral to the design and implementation of RBF schemes.

Furthermore, integrating digital health technologies and artificial intelligence (AI) with RBF models, as suggested for future research, can enhance the efficiency and effectiveness of healthcare delivery. Policymakers should consider investing in these technologies to streamline data collection, monitoring, and analysis processes, making RBF schemes more robust and adaptive to emerging healthcare challenges.

**Future Research Directions concern:**

- **Scaling RBF Models:** Future research should explore the scalability of RBF models in different healthcare contexts and regions, examining the factors that influence successful implementation and sustainability.
- **Integration with Digital Health Technologies:** Integrating digital health technologies and artificial intelligence (AI) with RBF models could provide new avenues for enhancing healthcare delivery and monitoring performance.
- **Broader Economic Impact:** Further research should quantify the broader economic impacts of improved pediatric healthcare, linking health outcomes to educational attainment and economic productivity.

\* \* \*

The RBF intervention in Northern Uganda's pediatric healthcare has significantly improved healthcare quality and outcomes. The intervention effectively addressed limited resources and staffing shortages by aligning financial incentives with specific health goals. The findings underscore the

potential of RBF to drive long-term enhancements in healthcare delivery, with broader implications for economic and social development. This study provides valuable insights and evidence to support the scaling and adaptation of RBF models in similar settings worldwide.

Expanding the applicability of the RBF model beyond Northern Uganda to other similar settings is crucial for leveraging the universal benefits of this approach. The findings from Northern Uganda provide a robust foundation for adapting and implementing RBF in diverse global contexts, particularly in low- and middle-income countries (LMICs) facing similar healthcare delivery challenges.

**Broader Contextualization of Findings concerns:**

1. **Applicability to Other LMICs:**

○ The success of the RBF model in improving healthcare outcomes in Northern Uganda suggests its potential applicability in other LMICs with similar resource constraints and healthcare challenges.

○ Countries with varied healthcare infrastructure and funding mechanisms could adapt the RBF model to suit local conditions, focusing on specific health outcomes relevant to their unique public health challenges.

2. **Scalability across Different Healthcare Systems:**

○ The principles of RBF—linking financial incentives directly to performance outcomes—can be tailored to fit different healthcare systems' structures, whether they are predominantly public, private, or mixed.

○ Detailed documentation of the implementation strategies and outcomes in Northern Uganda provides a blueprint that other regions can modify to address local healthcare needs and priorities.

3. **Integration with Existing Health Policies:**

○ Integrating RBF can provide incentives to enhance performance and accountability in healthcare delivery for regions with existing health strategies that have not fully met the desired outcomes.

○ Policymakers can incorporate RBF mechanisms into broader health reforms to drive improvements in efficiency and effectiveness, aligning with Sustainable Development Goals (SDGs) such as good health and well-being.

4. **Adaptation to Specific Health Challenges:**

○ RBF can incentivize healthcare providers to improve disease management and control efforts in



settings with high disease burdens, such as regions with malaria or tuberculosis.

○ For countries striving to improve maternal and child health indicators, adapting the RBF model to focus on reducing mortality rates and increasing access to prenatal and postnatal care can yield significant benefits.

Recommendations for Global Applications rely on:

1. **Pilot Studies and Gradual Rollout:**

○ Before full-scale implementation, conducting pilot studies in selected regions can help identify potential challenges and necessary adaptations for the RBF model to succeed in different settings.

○ Gradual rollout allows for iterative adjustments based on real-time feedback, enhancing the model's effectiveness and sustainability.

2. **Capacity Building and Training:**

○ Implementing RBF requires robust training programs for healthcare providers and administrators to understand and effectively engage with the new financing model.

○ Building local capacities for data collection, analysis, and performance evaluation is essential to maintain the integrity and effectiveness of the RBF approach.

3. **Stakeholder Engagement and Public Awareness:**

○ Engaging all stakeholders—including healthcare providers, patients, policymakers, and community leaders—is crucial for the acceptance and success of RBF schemes.

○ Public awareness campaigns can educate communities on the benefits of RBF, garnering public support and ensuring community involvement in monitoring health service improvements.

4. **Continuous Monitoring and Evaluation:**

○ Establishing a robust monitoring and evaluation framework is vital to assess the ongoing impact of RBF, allowing for timely modifications to enhance program outcomes.

○ Regular assessment helps maintain transparency and accountability, which are key factors for the long-term success of RBF initiatives.

By considering these broader implications and recommendations, the RBF model from Northern Uganda can serve as a valuable model for improving healthcare delivery and outcomes in various global settings. This approach enhances healthcare quality and contributes to broader economic and social development goals.

## 6. Conclusion

The RBF intervention in Northern Uganda's pediatric healthcare, specifically at Lacor and Kalongo hospitals, has demonstrated substantial potential in improving healthcare quality and outcomes in resource-limited settings. This study has provided valuable insights into RBF's immediate and long-term impacts, addressing critical gaps in the literature and offering practical recommendations for future implementations and research.

Key Findings include:

a) **Immediate and Sustained Improvements:** The RBF model successfully improved key performance metrics such as hygiene, clinical processes, emergency readiness, and training during its implementation phase (2018-2020). Importantly, these improvements were largely sustained four years post-intervention, indicating the long-term viability of RBF in maintaining high healthcare standards even after financial incentives ceased.

b) **Context-Specific Adaptation:** The differing trajectories of improvement between Lacor and Kalongo hospitals highlight the importance of tailoring RBF models to healthcare facilities' specific needs and starting points. This adaptability ensures that both higher-baseline and lower-baseline institutions benefit from RBF schemes.

c) **Impact on Health Outcomes:** The intervention significantly reduced child mortality rates and increased vaccination coverage, underscoring the direct benefits of enhanced healthcare quality. These outcomes have broader implications for human capital development and economic growth, as healthier children are more likely to achieve better educational and life outcomes.

Practical Insights refer to:

a) **Comprehensive Data Collection:** Future RBF implementations should prioritize robust data collection and monitoring frameworks. Regular evaluations and adjustments based on real-time data are crucial for sustaining high performance.

b) **Stakeholder Engagement:** Active involvement of healthcare providers, administrators, and the community is essential for the success of RBF schemes. Ensuring that all stakeholders are aligned with the goals and understand the benefits of RBF can drive more effective and sustainable improvements.

c) **Training and Supervision:** Continuous training and consistent supervision are vital. The study found that fluctuations in training quality due to supervisor absences or student rotations can impact overall



performance. Structured training programs and stable supervision arrangements are recommended.

d) **Flexibility to Adapt to Crises:** The COVID-19 pandemic highlighted the need for RBF models to be flexible and adaptive. Incorporating contingency plans and flexible funding mechanisms can help healthcare systems maintain performance standards during crises.

Recommendations for Future Research concern:

a) **Long-Term Impact Studies:** Further research should focus on long-term impact assessments of RBF interventions across different regions and healthcare contexts. Understanding how these models perform over extended periods can provide deeper insights into their sustainability.

b) **Integration with Technology:** Integrating digital health technologies and Artificial Intelligence (AI) with RBF models can open new avenues for enhancing healthcare delivery and monitoring performance. Technology can streamline data collection and analysis, making RBF schemes more efficient.

c) **Economic Impact Analysis:** Future studies should quantify the broader economic impacts of improved pediatric healthcare due to RBF. Linking health outcomes to educational attainment and economic productivity can provide a more comprehensive understanding of the value of RBF interventions.

d) **Comparative Studies:** Conducting comparative studies between different RBF implementations across various healthcare settings can identify best practices and common challenges. This comparison can guide the refinement and adaptation of RBF models to diverse healthcare environments.

\* \* \*

The RBF intervention in Northern Uganda has provided compelling evidence of its efficacy in enhancing pediatric healthcare quality and outcomes. By aligning financial incentives with specific health goals, RBF models can effectively address the challenges of limited resources and staffing shortages.

This study contributes to the growing body of evidence supporting RBF as a viable strategy for healthcare improvement, offering practical insights and recommendations for future implementations. With continued research and adaptation, RBF can be crucial in advancing global health goals and improving healthcare delivery in resource-limited settings worldwide.

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### Acknowledgments

We thank Cyprian Opira (Executive Director), Odong Emintone (Medical Director), Ogwang Martin (Institutional Director) of St. Mary's Hospital Lacor; Dominique Corti, Bruno Corrado, Carolina Laghi (Fondazione Corti), Tito Squillaci, Margherita Arcidiaco, Giovanna Ambrosoli (Ambrosoli Foundation) for their support in the design and on-field implementation. The usual disclaimer applies.

### Ethical Approval

Ethical approval was not required as the study did not involve human participants.

### Informed Consent

This article contains no studies with human participants performed by any authors.

### Competing Interests

The authors declare no competing interests.

### Contributions

Conceptualization, Roberto Moro-Visconti, and Luigi Greco; Data curation, Luigi Greco; Formal analysis, Godfrey Smart and Emmanuel Ochola; Investigation, Venice Omona, and Godfrey Smart; Methodology, Venice Omona, Emmanuel Ochola and Luigi Greco; Resources, Elisabetta D'Agostino; Writing – original draft, Roberto Moro-Visconti; Writing – review & editing, Roberto Moro-Visconti.

### Data Availability

Data sharing does not apply to this research as no data were generated or analyzed.

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