

Cost-Effectiveness Analysis of Using a Smartphone Application to Improve Timely Vaccination Among Children in the Zaatari Refugees Camp, Jordan

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BACKGROUND

Immunization of children is a crucial strategy for preventing unvaccinated fatalities and disease outbreaks. According to the World Health Organization (WHO) 2021, an estimated 23 million children under one year did not receive essential vaccines in 2020, the highest number since 2009. The global immunization coverage dropped by 3% in 2020 compared to 2019. Using a smartphone application can act as a tool for enhancing vaccination by documenting the history of vaccination, sending timely reminders, and delivering health promotional material like parenting skills to improve health literacy for family members. An economic evaluation was done to understand the cost-effectiveness of a smartphone application (app) called Children Immunization App (CIMA), used as a reminder for vaccine appointments for children in the Zaatari refugee camp in Jordan.

AIM & OBJECTIVES

This study aimed to analyze the cost-effectiveness of the smartphone app called Children Immunization App (CIMA) as an intervention for improving timely immunization for oral polio vaccine (OPV) among children in the Zaatari refugee camp in Jordan. The app served its purpose as a vaccine record, reminder and source of health promotional information.

METHOD

- A health economic evaluation was done using cost-effectiveness analysis, which compared a smartphone-based app to remind parents to bring their child for OPV immunization with a control group of caretakers visiting the same camp clinic without receiving the app.
- Cost data for the intervention was collected from the financial statements used in the CIMA project, information from the Ministry of Health, Jordan, and a questionnaire was sent to key informants. The effectiveness of the intervention measured the change in the number of children immunized against polio in time. Such data were collected from trials conducted in the CIMA project. Subsequently, the cost-effectiveness of the implemented intervention was calculated as well as an ICER for scaling up the intervention by expanding usage of the app to more families.
- The total intervention cost was calculated using the full costing approach, which includes all the initial investment and management of the research project. The total cost was adjusted to the average inflation rate from 2018 to 2022, drawn from the Central Bank of Jordan and World Bank Data to the current price.
- The target population for the intervention in the primary study was refugee children aged 0 to 5 years whose parents have an Android smartphone for CIMA installation. The impact of receiving vaccination on time using the app as a reminder about vaccination was assessed.
- Additionally, vaccine cost for Oral Polio Vaccine was estimated from the camp perspective.

$$ICER = \frac{[Intervention\ group\ (Cost\ of\ vaccination\ on\ time) - Control\ group\ (Cost\ of\ vaccination\ on\ time)]}{Additional\ Child\ vaccinated\ on\ time}$$

Table 1 Total Program Cost for Child Immunization App (CIMA), March –October 2019)

		Cost (JOD)* of intervention	Cost (JOD) of evaluation and scaling Up	Description
Program cost	Administrative			Project administrative cost for implementing the intervention.
	Goods and supplies	1,720	1,720	
	Project Administration cost	1,314	1,314	
	Sub-Total	3,034	3,034	
Cost of app development		10,417	-	The total cost of developing the mobile application, App developer's fees, and platform fees to run on android.
Maintenance cost (App)		2,604	2,604	Annual fees for running the app on the platform/Android, App developers' fees for fixing any major bugs or troubleshooting.
Staff salaries		27,049	27,409	Salaries of field staff, Investigators, and project director
Training cost		6,229	6,229	Training the staff about the intervention, travel cost, and workshops
Consultancy services/ subcontract staff		2,781	-	Services used for translation, monitoring, and preparing training material for the intervention.
Total cost		52,114 JOD	38,917 JOD	
Adjusting the inflation – 2022		55,110 JOD	41,154 JOD	

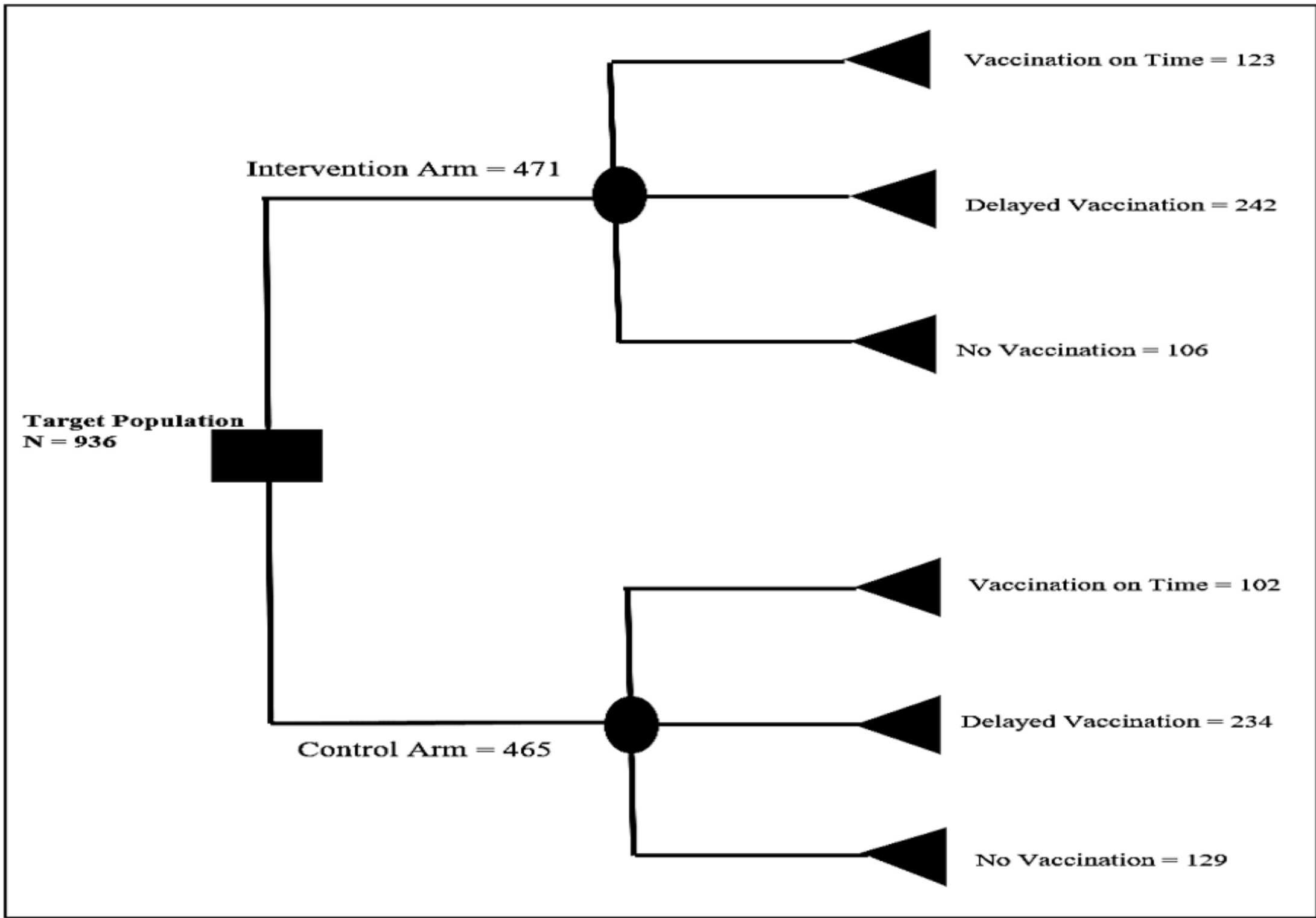
*Jordanian Dinar; Source: Grand Challenges Canada (GCC) Ledger files

Table 2 – Cost estimate of Oral Polio Vaccine (JOD & 2022)

Parameter	Quantity	Cost	Description
Number of Children to be vaccinated in Zaatari Camp	14600	-	Assuming all the children 0-5 years receive 1 dose of OPV ¹
Total operational cost	14600	1389 JOD	Cost includes staff salaries and administrative cost
Staff salaries		1200 JOD	A total of 4 staff work at 2 vaccination clinics in camp ¹ . The average annual salary of Nurses is 6000 JOD, including benefits and allowances. Assuming approx. 5% of resources are allocated for OPV in a year.
Administrative cost		189 JOD	Administrative work includes ² 2 Nurses and a medical doctor working 32 hours and 4 hours a month, respectively. The average annual salary for a doctor is 10800 JOD. Assuming approx. 5% of resources are allocated for OPV in a year.
Net operational cost per dose	1	0.10 JOD	Operational cost in the camp, excluding the logistic cost
Cost of equipment and logistics	1	1.33 JOD	Delivery cost for vaccine distribution per dose. The estimated cost is 1.87 USD ³
Purchase cost of OPV	10	5 JOD	Oral polio vaccine costs 5JOD per vial with 10 doses. (Cost of procurement for MOH, Jordan) ² .
Wastage per vial in the camp	10%		Average wastage in a camp setting ² .
Net purchase OPV cost per dose		0.56 JOD	

Source: ¹ UNHCR 2022 report ² Key Informants – Ministry of Health; ³ UNICEF 2020 report.

Figure 1 - Schematic representation of trial.



RESULTS

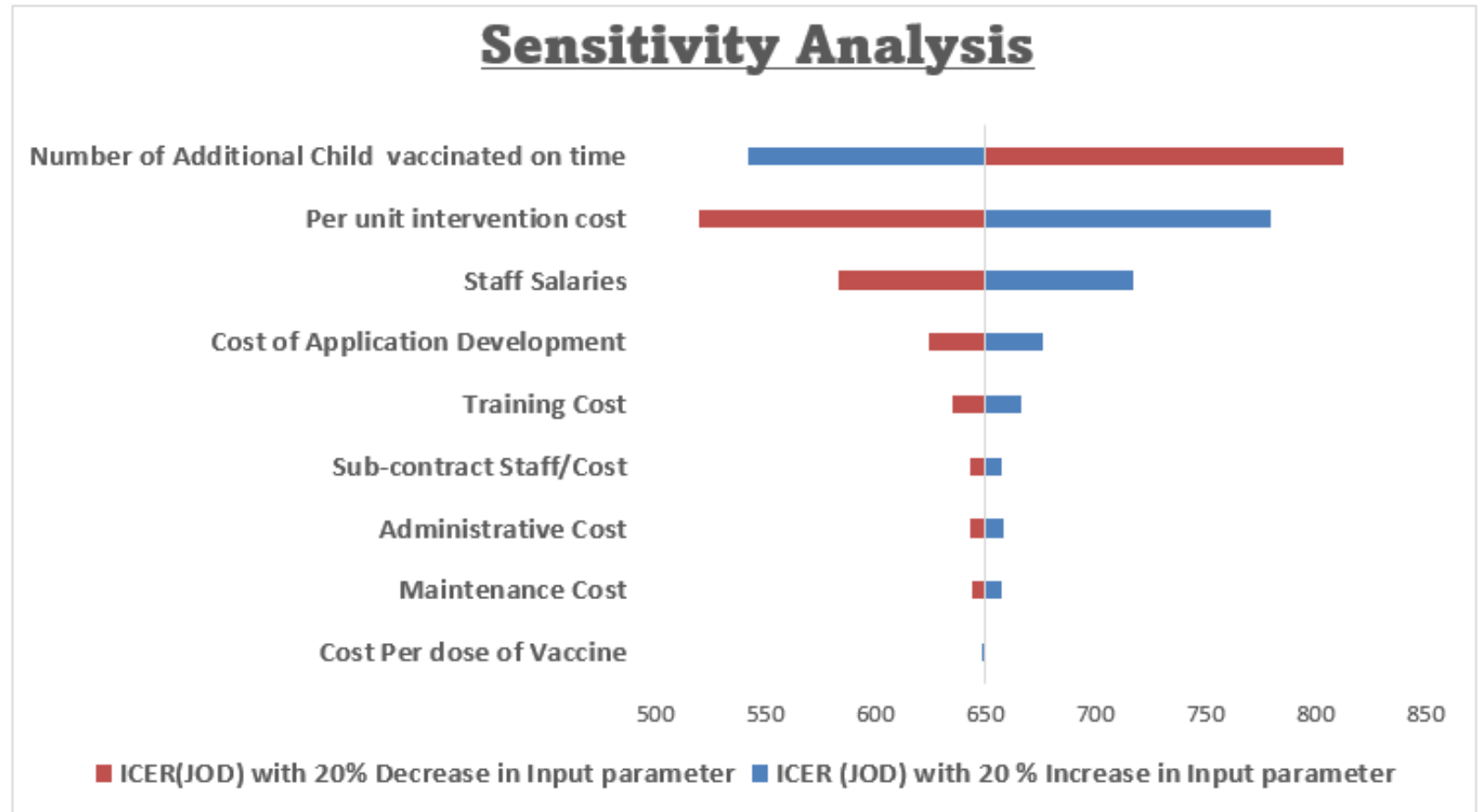
The average intervention cost per child was 165 US\$, with an ICER of 917 US\$. However, if the intervention were implemented for all children aged 0-5 years in Zaatari camp, the cost per child using the app was estimated to be **3.97 US\$**, including the evaluation and the implementation cost for running the intervention. Further, the cost of running the app per child would be **0.25 US\$**.

The average cost of immunizing each child with one dose of OPV in the camp setting is **1.98 JOD (2.79 US\$)**, including the administrative, delivery, and vaccine costs.

Table 3 – Oral Polio Vaccine Cost in Zaatari Camp, Jordan (2022).

Cost	
Cost per dose	1.98 JOD (2.79 US\$)
Vaccine Wastage Cost per dose	0.50 JOD (0.71 US\$)
Operational Cost per dose	0.10 JOD (0.13 US\$)

Figure II - Univariate Sensitivity Analysis on ICER (JOD & 2019):



CONCLUSION

This study makes the following conclusion after conducting the economic evaluation on CIMA intervention as a smartphone app to be a low-cost tool to remind families to get their children immunized in time in scarce settings like refugee camps.

Moreover, compliance with using the app was observed to be higher among refugee settings, suggesting further research to evaluate the health outcome of the intervention in a large population setting.

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