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# Economic evaluation of the integrated care model and its scalability in Zimbabwe

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**Abstract**

**Background:** Researchers and policy makers in middle to low income countries still face challenges in recommending the community models that are cost-effective, sustainable and that can be integrated into the mainstream community health care systems. Many community models have failed this acid test as they either only prove to be effective at pilot-stage life but the gains fail to be sustained in pragmatic situations. This study sought to determine the cost-effectiveness of the Integrated Care Model by doing an economic analysis comparing the Integrated Care Model and the conventional health care mobilisation system in Zimbabwe.

**Methods:** The economic evaluation was conducted with a pragmatic trial that employed the quasi-experimental approach to determine the long term effectiveness of the Integrated Care Model in improving Child health outcomes in Zimbabwe. Villages from two health centres we randomised either to the intervention or control arm. Average Cost effective ration and Incremental Cost Effectiveness ratios were used to assess and compare the cost-effectiveness of the two interventions.

**Results:** The overall ACER for the intervention and the control were 8 412 and 31 618 respectively whereas the overall ICER was 27 212 for Figure 4 below is a representation of the average cost effectiveness ratio for all the disease condition and Figure 5 is a depiction of the ICERs for the study conditions. The overall risk of morbidity was 0.9 in the intervention and 5.8 in the control giving a risk ratio of 6.8 (95% CI (5.94 - 7.77), $P< 0.0001$). We used the CEA four plane model to determine the overall effectiveness of the intervention. Figure 7 below is a graphical representation of our results on a cost-effectiveness plane plotting net-cost against effect. The study of the net-cost against intervention effect revealed that the study intervention falls in the lower right quadrant, meaning that the intervention is cost-effective (More effective and less costly).

**Conclusion:** The study results revealed that the Integrated Care Model is a cost-effective model that can improve child health outcomes in low-resource settings. Governments in low to medium income countries can scaling up such low cost-high impact interventions.

**Keywords:** Cost-effectiveness analysis, health outcomes, integrated care model

## Introduction

High preventable maternal and child morbidity and mortality rate remains a big barrier to the achievement of Sustainable Development Goals especially Sustainable Development Goal number three which targets universal coverage of health services and eradication of child and maternal mortality by 2030. Zimbabwe has one of the highest maternal and child morbidity and mortality rates with child mortality standing at 96/1000 livebirths and maternal mortality standing at 651/100 000 livebirths [1]. Studies have shown that more than 70 percent of these deaths are preventable and occur at community level. Such poor health outcomes are attributable to poor community mobilization structures that fail to reach saturation coverage with community health services.

The Primary Health Care approach dictates that health services should be decentralized to each household and communities should be engaged and be accountable collectively to their health, with governments committing themselves to providing equitable, accessible, affordable services to all individuals regardless of their race, gender and ethnicity [2]. Achieving such a target in Zimbabwe has always been a big challenge since 1980 due to a multiplicity of factors and one of them being resource constraints and the other biggest challenge being the absence of an effective community mobilization structure that is integrated into the health delivery systems and reaching saturation coverage in a sustainable way in all targeted communities.

Behaviour change communication is critical for increasing the promotion of particular behaviours known to promote quality maternal and child health services uptake [3]. The approaches used to change behaviour are important for predicting and determining how successful the intervention is. An effective integrated model for community mobilisation makes use of findings from different interventions, techniques used before and these should be linked with effectiveness data.

Effective community mobilisation approaches are those that effectively utilise community health workers to maintain consistent and regular contact with households, developing strong partnerships with the served communities to improve child-health outcomes. Currently there is still limited evidence about the effectiveness and cost-effectiveness of integrated community- based approaches in reducing child morbidity. Policy makers in health are lured by community programmes that are both sustainable and effective. Close integration between community health interventions and primary health facilities are critical elements of effectiveness.

Cost-effectiveness analysis (CEA) can be used to make comparisons of different interventions for the same disease, comparisons of different interventions for reaching specific segments of a population and comparisons of different interventions for different diseases. Scarce resources will generate more health improvements when they are applied to interventions that are more cost-effective.

The measures that have been used to determine CEA in public health include Average Cost Effectiveness Ratio (ACER) and Incremental Cost Effectiveness Ratio (ICER). By definition, the ACER a healthcare intervention is calculated by dividing the intervention cost by its effectiveness, and can be graphically represented by a line connecting the origin of the cost-effectiveness plane through the point consisting of the costs and effectiveness of the intervention. By graphically comparing the ACER of two interventions, the line with a lower slope has a lower ACER. This means that if one knows the ACER of two interventions, we can only be certain that the intervention with a higher ACER cannot dominate an intervention with a lower ACER.

The cost effectiveness plan has also been introduced in CEA for public health interventions.

The main limitation of most cost-effectiveness analysis calculations is that they consider the costs of producing an intervention but not the costs of consuming it on the part of patients and their families. Indirect costs are often not monetary, especially the costs of people's time, and are hard to estimate consistently. When such costs are high, they make interventions appear not to be cost-effective, but the problem may lie with where facilities are sited and how they are staffed and operated rather than with the interventions they offer.36

## Methods

### Study design

This was a pragmatic trial and a quasi-experimental designs was used. The study used population based sampling to enrol villages into either intervention sites or control sites. Target sampling was used to enrol children aged 0-48 months into the study. The study was conducted in line with ethical principles enshrined in the Declaration of Helsinki. Permission to conduct the study was obtained from the Medical Research Council of Zimbabwe (MRCZ), approval number A/2099.

### Study population and setting

The study was conducted in two rural health centres in Murewa district, which falls in Mashonaland East province of Zimbabwe. The two health centres were Murewa polyclinic and Macheke rural clinic. Murewa polyclinic has a total of 17 villages where as Macheke clinic has a total of 13 villages. The two health centres have a total population of 45 203. About 15% of these are under-fives and 22% of the population are women of child bearing age (Murewa District profiles, 2019). Women of child-bearing age (15-49 years) made up the study population and the study targeted pregnant women and women with children 48 months old or younger.

### Study interventions

Our community mobilisation model, the Integrated Care Model (ICM) was first evaluated in 2017 in Mashonaland East province. We conducted a cluster randomised controlled trial to evaluate the immediate effects of the Integrated Care Model (ICM) versus the conventional community mobilization model on child morbidity over 12 months. A year later, following the completion of the first evaluation we assessed the long-term effects of the intervention on child morbidity, in the same study setting.

### Data analysis

To determine the cost effectiveness of the intervention, we used the Average Cost Effectiveness Ratio (ACER) and the Incremental Cost Effectiveness Ratio (ICER). The effect of the intervention on health outcomes as determined through calculation or risks, risk differences, risk ratio and Incidence rate ratio in STATA 16. The trial's primary endpoint will be child morbidity during 18 months of follow-up.

## Results

Comparison of cost for Pneumonia treatment and Intervention effect the study compared the cost of pneumonia prevention and management through the Integrated Care Model versus the conventional community health mobilisation model. Table 1 below summarises the results.

**Table 1:** Comparison of cost for Pneumonia treatment and Intervention effect

| Description | Intervention | Control |
|---|---|---|
| | Related costs (in USD) | Related costs (in USD) |
| Logistical costs in the implementing in the two sites | 132.6 | 132.6 |
| Allowances for nurses (research assistants | 375.7 | 375.7 |
| Training of volunteers on the Integrated Care Model | 238.68 | 0 |
| Allowances for VHWs | 2148.12 | 1790.1 |
| Community Volunteer training | 238.68 | 0 |
| Development and printing of promotional material and tools (incentives) and manuals | 1326 | 88.4 |
| Nurses' salaries (18 months) | 1153 | 1153 |
| Utility bills(water/electricity) (18 months) | 331.5 | 331.5 |
| Phone Bills | 132.6 | 132.6 |
| Supervision costs | 88.4 | 88.4 |
| Total cost for treating Pneumonia case | 14950 | 80850 |
| Total cumulative costs | 21115.28 | 84942.3 |

| Health outcomes | | |
|---|---|---|
| Cumulative Pneumonia cases | 299 | 1617 |
| Risk of child morbidity | 0.38 | 2.75 |
| Risk ratio | 7.2 95% CI ((6.94 - 7.87), $p < 0.0001$ | |

**Cost effectiveness analysis for Pneumonia treatment**

We calculated and compared the Average Cost Effectiveness ratios for both the intervention and the control. ACER was calculated as total cost of intervention divided by the Benefit of the Intervention (Effect on health outcome). The ACER for the intervention was 33 923 and 84 942 for the control. This meant that the study intervention was more effective.

We calculated the Incremental Cost Effectiveness Ratio for the treatment of pneumonia using the formula: ICER = (Total cost of intervention – Total cost of control)/ (Intervention Benefit – Control Benefit). Risk differences was used to measure net intervention effect. The ICER for pneumonia management was 26903 and this meant that, implementation of the conventional community mobilisation model results in an extra cost of $26 903 per life year.

**Comparison of cost for Diarrhoea treatment and Intervention effect**

Table 2 below summarises the costs for diarrhoea management and treatment effects.

**Table 2:** Comparison of cost for Diarrhoea treatment and Intervention effect

| Description | Intervention | Control |
|---|---|---|
| | Related costs (in USD) | Related costs (in USD) |
| Logistical costs in the implementing in the two sites | 120 | 120 |
| Allowances for nurses (research assistants | 340 | 340 |
| Training of volunteers on the Integrated Care Model | 216 | 0 |
| Allowances for VHWs | 1944 | 1620 |
| Community Volunteer training | 216 | 0 |
| Development and printing of promotional material and tools (incentives) and manuals | 1200 | 80 |
| Nurses' salaries (18 months) | 461.2 | 461.2 |
| Utility bills(water/electricity) (18 months) | 300 | 300 |
| Phone Bills | 120 | 120 |
| Supervision costs | 80 | 80 |
| Total costs for diarrhoea treatment | 20100 | 88275 |
| Total cumulative costs | 25097 | 91396 |
| **Health outcomes** | | |
| Cumulative Diarrhoea cases | 268 | 1177 |
| Risk of child morbidity | 0.34 | 2.00 |
| Risk ratio | 5.9 95% CI (4.78- 6.18), $p < 0.0001$ | |

Figure 1 below is a diagrammatic representation of the two ACERs for the two study arms. The study Intervention had a lower slope than the conventional intervention and this meant that the study intervention was more effective.

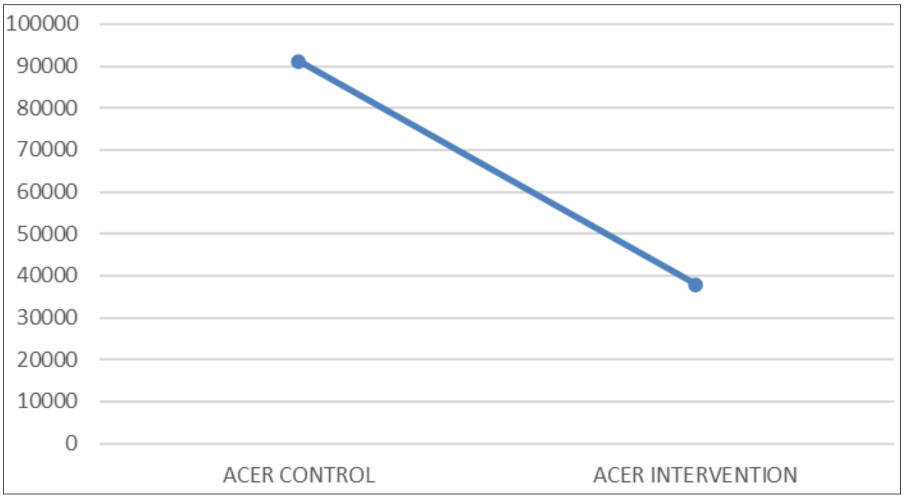


**Fig 1:** Comparison of the ACER for Diarrhoea treatment

The ICER for diarrhoea management was 39 860 and this meant that, implementation of the conventional community mobilisation model results in an extra cost of $39 860 per life year.

**Comparison of cost for Fever treatment and Intervention effect**

Table 3 below outlines the result on the cost and intervention effect for fever management

**Table 3:** Comparison of cost for Fever treatment and Intervention effect

| Description | Intervention | Control |
|---|---|---|
| | Related costs (in USD) | Related costs (in USD) |
| Logistical costs in the implementing in the two sites | 39.9 | 39.9 |
| Allowances for nurses (research assistants | 113.05 | 113.05 |
| Training of volunteers on the Integrated Care Model | 71.82 | 0 |
| Allowances for VHWs | 646.38 | 538.65 |
| Community Volunteer training | 71.82 | 0 |
| Development and printing of promotional material and tools (incentives) and manuals | 399 | 26.6 |
| Nurses' salaries (18 months) | 153.349 | 153.349 |
| Utility bills(water/electricity) (18 months) | 99.75 | 99.75 |
| Phone Bills | 39.9 | 39.9 |
| Supervision costs | 26.6 | 26.6 |
| Total cost for fever treatment | 900 | 5750 |
| Total cumulative costs | 2561.569 | 6787.799 |
| **Health outcomes** | | |
| Cumulative fever cases | 90 | 575 |
| Risk of child morbidity | 0.11 | 0.98 |
| Risk ratio | 8.6 95% CI (7.18 - 10.6), $p < 0.0001$ | |

**Cost effectiveness analysis for Fever treatment**

The ACER for the intervention was 2890 and the ACER for control was 6 788. The study intervention had a strong domination over the conventional intervention. Figure 2 below is a representation of the two ACERs for the two study arms. It is clear from figure 2 that

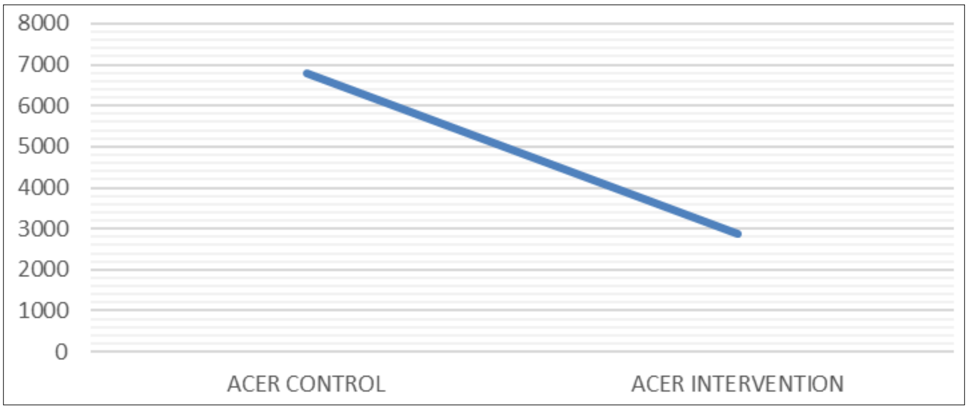


**Fig 2:** Comparison of the ACER for Fever treatment

The ICER for Fever management was 4 890 and this meant that, implementation of the conventional community mobilisation model results in an extra cost of $4 890 per life year.

**Comparison of cost for Malaria treatment and Intervention effect**

The comparison of cost for malaria management and intervention effect is presented in Table 4.

**Table 4:** Comparison of cost for Malaria treatment and Intervention effect

| Description | Intervention | Control |
|---|---|---|
| | Related costs (in USD) | Related costs (in USD) |
| Logistical costs in the implementing in the two sites | 9 | 9 |
| Allowances for nurses (research assistants | 25.5 | 25.5 |
| Training of volunteers on the Integrated Care Model | 16.2 | 0 |
| Allowances for VHWs | 145.8 | 121.5 |
| Community Volunteer training | 16.2 | 0 |
| Development and printing of promotional material and tools (incentives) and manuals | 90 | 6 |
| Nurses' salaries (18 months) | 34.59 | 34.59 |
| Utility bills(water/electricity) (18 months) | 22.5 | 22.5 |
| Phone Bills | 9 | 9 |
| Supervision costs | 6 | 6 |
| Total costs for treating Malaria | 400 | 900 |
| Total cumulative costs | 774.79 | 1134.09 |
| **Health outcomes** | | |
| Cumulative fever cases | 20 | 45 |
| Risk of child morbidity | 0.03 | 0.08 |
| Risk ratio | 3.0 95% CI (1.81 - 5.08), $p < 0.0001$ | |

**The ACER for the intervention was 795 and 12 28 for the intervention and the control respectively**.
With a lower slope, the intervention was dominant over the conventional mobilisation model. Figure 3 below is a representation of the two ACERs for the two study arms.

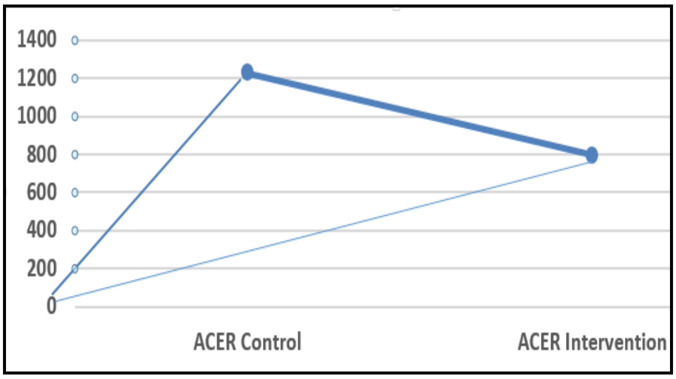


**Fig 3:** Comparison of the ACER for Malaria treatment

The ICER for Malaria management was 7 007 and this meant that, implementation of the conventional community mobilisation model results in an extra cost of $7 007 per life year.

**Overall cost effectiveness of the intervention**
The overall ACER for the intervention and the control were 8 412 and 31 618 respectively whereas the overall ICER was 27 212 for Figure 4 below is a representation of the average cost effectiveness ratio for all the disease condition and Figure 5 is a depiction of the ICERs for the study conditions.

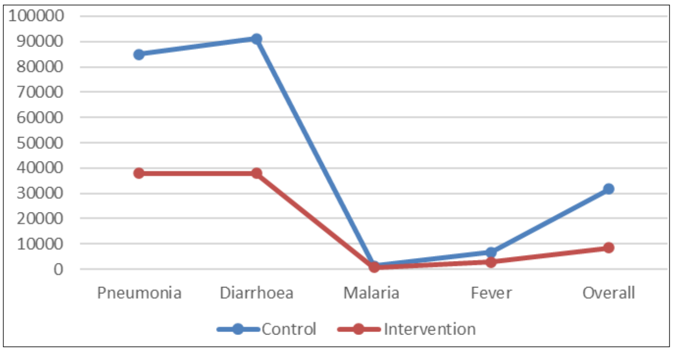


**Fig 4:** Comparison of the ACER for treatment of childhood illnesses

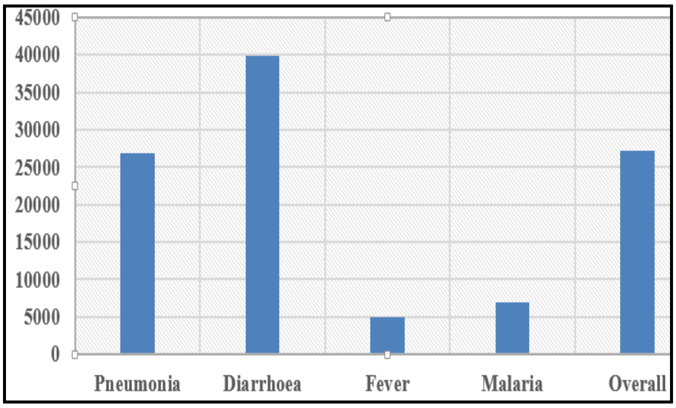


**Fig 5:** ICER for different childhood illness treatment

The overall risk of morbidity was 0.9 in the intervention and 5.8 in the control giving a risk ratio of 6.8 (95% CI (5.94 - 7.77), $P < 0.0001$). We used the CEA four plane model to determine the overall effectiveness of the intervention. Figure 7 below is a graphical representation of our results on a cost-effectiveness plane plotting net-cost against effect.

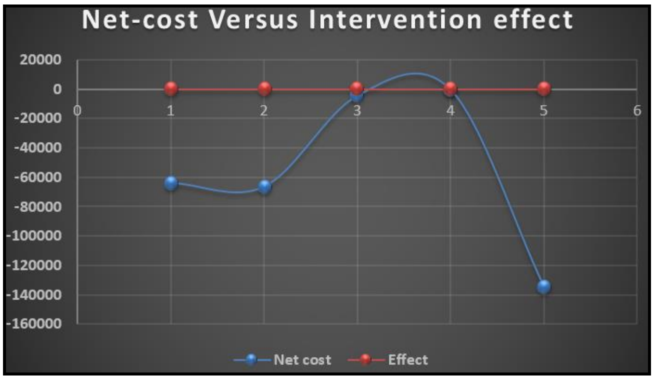


**Fig 6:** Net-cost versus intervention effect

The study of the net-cost against intervention effect revealed that the study intervention falls in the lower right quadrant, meaning that the intervention is cost-effective (More effective and less costly).

**Discussion**
The primary healthcare approach dictates that there should be a saturation coverage of all communities and households with preventive, promotive and rehabilitative interventions. Zimbabwe is a developing country, hence like any other developing countries suffer economic challenges and resource constraints in health delivery. Very few programmes have also taken an initiative to promote high accountability and meaningful participation of communities in their own health and later on do a cost-benefit and cost-effectiveness analysis of their interventions.
As a result, some novel innovations have not achieved optimal results because they were heavily managed and influenced by a greater proportion of external staff and for a fixed time period. There is a greater chance of survival and effectiveness if a community mobilisation approach is fully integrated into the mainstream health delivery structure as opposed to stand alone programmes.
A study by the National Center for Policy Analysis at Harvard University focused on 185 life-saving interventions that take place in the United States each year, costing US$21.4 billion and saving 592,000 life years. The study investigated different ways of allocating these funds and found that the number of life years saved could be doubled if resources were reallocated to more cost-effective interventions [11].
A study in Benin used comparative costs and cost-effectiveness of behavioral interventions to evaluate HIV prevention strategies [12]. Costs were collected for provider inputs required to implement the interventions in 2009 and analysed by 'person reached'. Cost-effectiveness was analysed by 'person reporting systematic condom use'. Sensitivity analyses were performed on all uncertain variables and major assumptions. Cost-per-person reached varies by method, with public outreach events the least costly (US$2.29) and billboards the most costly (US$25.07).

The study results revealed that the Integrated Care Model is a cost-effective model that can improve child health outcomes in low-resource settings. Governments in low to medium income countries can scaling up such low cost-high impact interventions.

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