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Title: Cost effectiveness analysis of Performance Based Financing in Maternal and Child Health in Borana Zone

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Statement of Declaration

I, the undersigned hereby declare that the study which is presented in this thesis entitled on: “The Cost Effectiveness Analysis of Performance Based Financing in Maternal and Child Health in Borana, Ethiopia “is original work of my own. It has not been presented for a partial fulfillment for any educational qualification at this university or any other or in any projects by any means. All that all materials and sources used for this project research have been accredited appropriately.

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Certificate of Approval

This is to certify that the thesis prepared by Zeweter Temesgen, MD, entitled “Cost Effectiveness Analysis of Performance Based Financing on Maternal and Child Health in Borana zone” and submitted in partial fulfillment of the requirements for the Degree of Masters of Public Health In Health Economics complies with the regulations of the University and meets the accepted standards concerning originality and quality.

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Acronyms and abbreviations

ANC – Antenatal care

CORDAID- Catholic Organization for Relief and Development

CEA- Cost effectiveness analysis

DALY's- Disability adjusted life year

FMOH- Federal ministry of health

HDA- Health Development Army

HEW- Health extension worker

IBF –Input Based Financing

ICER- Incremental cost effectiveness ratio

LMIC- Low and middle income countries

LiST- Lives Saved Tool

MCH- Maternal and child health

MDG- Millennium development goals

MMR- Maternal mortality rate

PBF- Performance based financing

PNC- Postnatal care

PMTCT- Prevention of Mother to Child Transmission

RBF- Results based financing

SBA-skilled birth attendance

SDG- Sustainable development goals

TT- Tetanus Toxoid

U5MR- Under five mortality rate

Abstract

Performance-Based Financing has been adopted as a strategic health financing model across many countries in sub-Saharan Africa and has been implemented in Ethiopia since 2015. The primary objective is to enhance the quality, coverage, and efficiency of healthcare service delivery, particularly in the area of maternal and child health.

This study aims to evaluate cost-effectiveness of Performance-Based financing in improving maternal and child health services in the Borana region of Ethiopia. A quasi-experimental research design was employed to compare Performance-Based Financing with traditional Input-Based Financing model. Secondary data on the utilization of maternal and child health services and the costs associated with providing those services were collected from CORDAID, the Oromia Regional Health Bureau, and the District Health Information System, retrospectively for the period between January and December 2022. A stratified random sampling was used to sample health facilities of Borana and the sample size was calculated as 4 hospitals and 35 health centers.

Cost-effectiveness was assessed using the Incremental Cost-Effectiveness Ratio, and the health impact was estimated using the Lives Saved Tool, a component of the Spectrum software. The maternal and child health services analyzed in this study included the first and fourth antenatal care visits, skilled birth attendance, and postnatal care.

The study found significant increase in the coverage of antenatal care and skilled birth attendance under the Performance-Based Financing model. Compared to the Input-Based Financing model, Performance-Based Financing resulted in an estimated 228 additional lives saved, while Input-Based Financing led to only 10. The cost per disability-adjusted life year averted was 8,735 for Performance-Based Financing and 383 for Input-Based Financing. These results suggest that Performance-Based Financing is a cost-effective strategy for improving maternal and child health service coverage and health outcomes in the Borana region of Ethiopia.

Key words: *Cost Effectiveness Economic Evaluation, Maternal and child health, Performance Based Financing*

1.1 Background

Maternal and child health (MCH) have been important focus of the public health and health sector for numerous decades. It is also known that effective management and interventions during pregnancy, child birth and post-partum period is proved to have resulted in significant reduction in maternal and child mortality. Globally, between 2000 and 2020 the maternal mortality ratio (MMR) decreased by 34%, going from 339 deaths to 223 deaths per 100,000 live births (1). Additionally, the total number of deaths among children under the age of five decreased from 12.5 million in 1990 to 5.3 million in 2018 which can be attributed to different health strategies throughout the years to improve MCH(2).

MCH has also been a priority in Ethiopia's healthcare system for decades. Although there was a notable decline in MMR and Under-5 Mortality Rate (U5MR), Ethiopia did not achieve the Millennium Development Goals (MDG), particularly MDG5 (3) but recent reports show a decline in MMR, U5MR and newborn mortality (4). Despite the efforts of governments, implementation of new MCH health interventions and new strategies should be done to further decrease this numbers.

The Federal Ministry of Health (FMOH) has a goal to eliminate preventable MCH deaths that is in line with achieving the current Standard Development Goals (SDG) targets 3.1 and 3.2 which is a transformative agenda for all countries to decrease maternal deaths to 70 per 100,000 live births and neonatal mortality to 12 per 1,000 live births by year 2030(4). Therefore, in order for the country to meet this goal it is essential to expand the implementation of multiple MCH interventions that has to be cost effective and are efficient.

Health Sector Transformation Plan II (HSTP) is a five-year health strategic plan for health in Ethiopia for the period of 2020/21–24/25 that aims at improving the health of the population through the realization of progress towards Universal Health Care (UHC). One of the components is health care financing which focuses on implementing new strategies that increase domestic resource mobilization and ensure sustainable health financing specially in LMIC's and resource limited setting such as Ethiopia.. (5)

A health care financing strategy known as Performance Based Financing (PBF) has been implemented in many African countries over the past two decades. It has also been included in

Health Sector Transformation Plan II (HSTP II) of Ethiopia as a financing reform interventions being one mode of the health financing strategy for future years (6).

PBF encompasses a health financing strategy that establishes a connection between payments or incentives to health providers or managers for the attainment of predetermined and quantifiable health outcomes with the main objective of improving service delivery and health outcomes.

Several low- and middle-income countries, including Ethiopia, have implemented PBF to enhance the quality and utilization different health services with main focus on of MCH (6). In Ethiopia PBF started being implemented initially in Borana, then after expanded to Jimma and West Gojjam zones in 2015, 2018 and 2021 respectively and has shown significant change in utilization and quality of MCH services.

The results of the program being positive the FMOH has future plans of institutionalizing PBF for health and to scale up the program country wide with the goals of improving the utilization and quality of MCH services (7).

1.2 Statement of the problem

Performance-Based Financing has been implemented in Ethiopia since mid-2015 through collaboration between the FMOH and the Oromia Regional Health Bureau (ORHB). The program, which began in the Borana zone, has since expanded to other regions including Jimma and North Achefer respectively (7) (11). The primary objectives of the program are to improve health service delivery, strengthen governance, and enhance the health information system (7), where this objectives aligned with the national Health Sector Transformation Plan II (HSTP II).

PBF has multiple measurable quantity and quality health service indicators which are incentivized on achieving predetermined goals. The results of the program on the three regions have shown meaningful change in all quantity and quality score indicators including MCH service indicators (7).

An important aspect of the PBF model is its results-based nature, where health facilities are rewarded financially based on verified performance. This approach is designed to increase accountability, motivate providers, and ensure efficient use of resources. By shifting the focus from inputs to measurable outcomes, PBF has the potential to improve both service utilization and

quality. However, this benefit must be balanced against the financial and operational investments required to run the program effectively, including verification systems, training, and administration.

PBF has accumulating evidence of enhancing the utilization and quality of crucial health care services, particularly those pertaining to maternal and child health in LMIC (Low and Middle income countries) particularly in Africa(8). However, an important question to ask is whether the total cost associated with implementing PBF program which includes operational costs, cost of establishing the payment system, cost of the necessary data systems, trainings and the incentives are justified by the health outcomes achieved. In addition, it is also important to ask if PBF has significant improvement health outcomes as compared to other methods of financing the health services, such as standard input-based financing, which remains the dominant approach in Ethiopia.

There are some studies on the cost effectiveness analysis (CEA) of health interventions in Ethiopia, including the CEA of malaria interventions (9), Cost analysis on maternal and neonatal health services which included 13 interventions where the impact by increasing coverage by 20 percent and estimating the Daly's averted which the results showed it to be cost effective(10). Also recent study was done on the effectiveness of PBF on maternal and child health in Jimma zone where the results showed that PBF is a cost effective strategy as compared to the standard method of financing health showing results that the program is cost effective (11).

This study was undertaken in Borana region and the geographic location making it rural pastoralist region is believed to present its own unique challenges such low access and coverage of maternal and child health services. Therefore, there is a need for context-specific studies on the cost-effectiveness of PBF on MCH in pastoralist region such as Borana, Ethiopia.

1.3 Rational and significance of the study

The implementation of PBF in the health sector has been expanded to various regions in Ethiopia, such as Borana, Jimma, and North Achefer. As of 2021, PBF has been full coverage in all health facilities in Borana and Jimma, with future plans to expand it nationwide and institutionalize it under the supervision of the Federal Ministry of Health (FMOH). PBF since 2023 has also expanded to other regions of Ethiopia to include Addis Ababa, Central Ethiopia and Somalia.

There are multiple economic evaluation methods which are done to investigate the monetary value associated with different health intervention and the extent of health outcome which overtime this analysis has helped shaping health policy and decision making (15).

Economic evaluation technique particularly Cost Effectiveness Analysis (CEA) are increasingly applied to evaluate and compare two or more health interventions in terms of the relative costs and outcomes aimed at enhancing health (15). This study aims to assess the cost-effectiveness of PBF more specifically evaluating the ICER (Incremental Cost Effectiveness Ratio) per DALY's (Disability Adjusted Life Years) in Maternal and Child Health (MCH) service in Borana zone.

Despite the growing body of evidence showing that PBF can improve service coverage and quality, there remains a significant gap in the literature regarding its cost-effectiveness, especially in rural, pastoralist settings like Borana. Most existing studies have focused on urban or high-access regions, leaving uncertainty about the value of Performance-Based Financing in low-resource, hard-to-reach contexts.

This research will contribute both practical and academic insights. Practically, it will provide policymakers and donors with evidence on the financial viability and impact of Performance-Based Financing in under-served areas. Academically, it will fill a gap in the Ethiopian and broader sub-Saharan African literature by offering context-specific economic evaluation data from a pastoralist region. Additionally, the study will enrich the academic discourse on the applicability, scalability, and efficiency of innovative financing mechanisms in diverse health system settings.

2. Literature review

This section provides a review of the literature on three subjects. The first one focuses on importance and consequences of PBF on the health system globally and in different settings both developed and developing countries including Ethiopia. The review will also summarize the existing literature on PBF in MCH in other low- and middle-income countries, highlighting the similarities and differences in the design, implementation, and evaluation of PBF program. In addition, to discuss the findings of different literatures of the PBF interventions.

The second subject will review different interventions on maternal and child health and lastly the third section tries to discuss about economic evaluation methods more specifically cost effectiveness analysis of interventions.

2.1 Performance Based Financing

PBF is a “systems reform approach, which offers an answer to the ‘how’ of achieving UHC and the SDG’s. This scheme have been expanding rapidly across low- and middle-income countries over the past 20 years with a primary focus on MCH and with considerable external financing from multilateral, bilateral and global health initiatives. In sub-Saharan Africa between 2006 and 2017, the number of countries implementing PBF increased from 3 to 32 (out of 46) (16). There is also a growing interest in PBF as a means to align the incentives of the health care providers with public health goals.

PBF is pragmatic meaning it is unlikely for PBF to be a homogenous intervention and its modalities and effects will be highly dependent on context. It has been implemented in many African countries over the past two decades in different sectors such as Education, Agriculture and public administration. There are countries like Rwanda, Burundi and Cameroon who had fully scaled up the program in health countrywide (8). In Ethiopia the pilot program was started at arid and pastoralist Borana zone in the 2015 which ended on June 2018. This was Phase I. The results was positive regarding the quality and utilization of health services which lead to scaling up to phase II of the project involving more woredas with catchment population of 488,556(7). In addition, in 2019 CORDAID with additional funding from Embassy of Kingdom of Netherland (EKN) it expanded the program to Jimma zone(7). In 2021 the program has covers 100% of health facilities in both Borana and Jimma zones.

The PBF program has verifiable quantity and quality indicators which are monitored quarterly. Multiple reports which are done annually and external reports has shown substantial improvement in health service utilization, access to essential service, service quality and reliability of data in 11 Hospitals, 165 health centers and 737 health posts with a total catchment population of 4,480,329 (7).

There are different studies done showing the impact of the PBF program in utilization of health services and health outcomes. In addition, there is also growing body of evidence on the design

and implementation (8) including some evidence of effectiveness from recent impact evaluations of (14).

Different findings show results that PBF is pragmatic there is a need for evaluation if the program is Cost Effective in the Ethiopian context compared to traditional financing mechanism, IBF. There are few studies done in Ethiopia on Impact of the program on Utilization and Completeness of Partograph in Jimma the results showing that PBF had improved the maternity care through the effective usage of partographs (6). There is also a recent study done in Jimma trying to evaluate the effectiveness of the program on MCH services the results showing it was a good use of funds with positive health outcomes (11). This study will aim to contribute to the broad evidence base informing LMICs on whether PBF can extend and improve maternal and child outcomes in a cost-effective way.

2.2 Maternal and child Health

Maternal and child health are areas that have gained critical attention globally and are main areas of concern when it comes to the public health. It has also been the main area of concern in LMIC's. The targets for MCH are all women in their reproductive age groups, i.e., 15 - 49 years of age, children, school age population and adolescents and they make up to 2/3 of the population.

Several factors can be attributed to poor maternal and child health outcomes to mention some inadequate access to healthcare services, poor nutrition, inadequate antenatal care, malnutrition, poor sanitation and limited education which also resulted in low-birth-weight infants, development delays in children and malnutrition.

Given the magnitude of the problem identifying policies, strategies and interventions that can increase coverage and prioritize maternal and newborn health (MNH) services is one of the main challenges on the global health agenda. In order to increase population coverage, to narrow disparities between income groups and to reduce maternal and perinatal mortality, many countries in the region are investing in innovative strategies to enhance health system performance (17). MCH should focus on addressing these problems, clarifying policy and program alternatives and identifying cost-effective health related program interventions that are likely to reduce morbidity and mortality.

The PBF program in Ethiopia has resulted in increase in the quality, quantity and utilization of MCH indicators such as ANC visits >4, PNC, Skilled delivery, C/S delivery, long term/short term family planning, SAM <5, immunization, Vit A supplementation in Borana, Jimma and West Gojjam zones(18). The results of implementation of PBF showing positive leap towards SDG transformative agendas 3.1 and 3.2 but with a drawback being suboptimal population coverage in a country with a population of 120,000,000 there is a need to scale up the program and being institutionalized by the MOH.

In studies done in other countries such as Nigeria results have shown that there is increase in the coverage of vaccination and Skilled Birth Attendance (SBA) by 13.7 and 5.7 (19). A study in Zimbabwe also showed increased rate of institutional deliveries and post-partum TT (Tetanus Toxoid) vaccination by 13.4 and 20 percentage points respectively when compared to the standard care control group (20). Results of a study done in Zambia has also shown that PBF not only increased the percentage of not only quality but coverage of contraception use, institutional delivery, post-natal care and vaccination by 19.5, 12.8, 8.2 and 29.4 respectively(21). In Afghanistan even though it increased in the coverage of MCH services the cost of implementation was deemed high (13)

2.3 Cost effectiveness analysis on health Interventions

Cost-effectiveness analysis (CEA) is economic evaluation tool for evaluating the economic and health impacts of interventions. Determining the cost effectiveness analysis for health interventions has been a concern globally, especially in LMIC and it has been a challenge for policymakers for prioritizing type of health intervention, on decisions to include new interventions, and on deciding how to allocate resources (22).

CEA provides a standardized means of comparing interventions to identify those that provide maximal clinical effect per incremental unit of cost. It is a form of economic analysis that compares the relative expenditures and outcomes of two or more strategies that perform the same task (23). There are two approaches to CEA which are Cost-per-quality-adjusted life year (QALY) gained and cost-per-disability-adjusted life year (DALY) averted.

These are metrics used to measure population health, which integrate morbidity and mortality. QALYs have been applied predominantly in higher-income countries while DALYs have been

used more extensively in global health analyses. The number of cost-per-DALY studies has grown in recent years, with many of these analyses focusing on health interventions in low- and middle-income countries as it captures both mortality in terms of years of life lost (YLL) and morbidity in terms of years of life with disability (YLD) (23).

Statistical methods for CEA have been developed and a measure, the incremental cost-effectiveness ratio (ICER) and has been supported by various authorities and most widely adopted by researchers and policy maker. It is measured as the ratio of the difference in costs to the difference in effectiveness between two strategies or interventions (22). In this study I will also be using ICER to compare the cost and health outcomes of the Borana Zone in Ethiopia compared with the input-based financing.

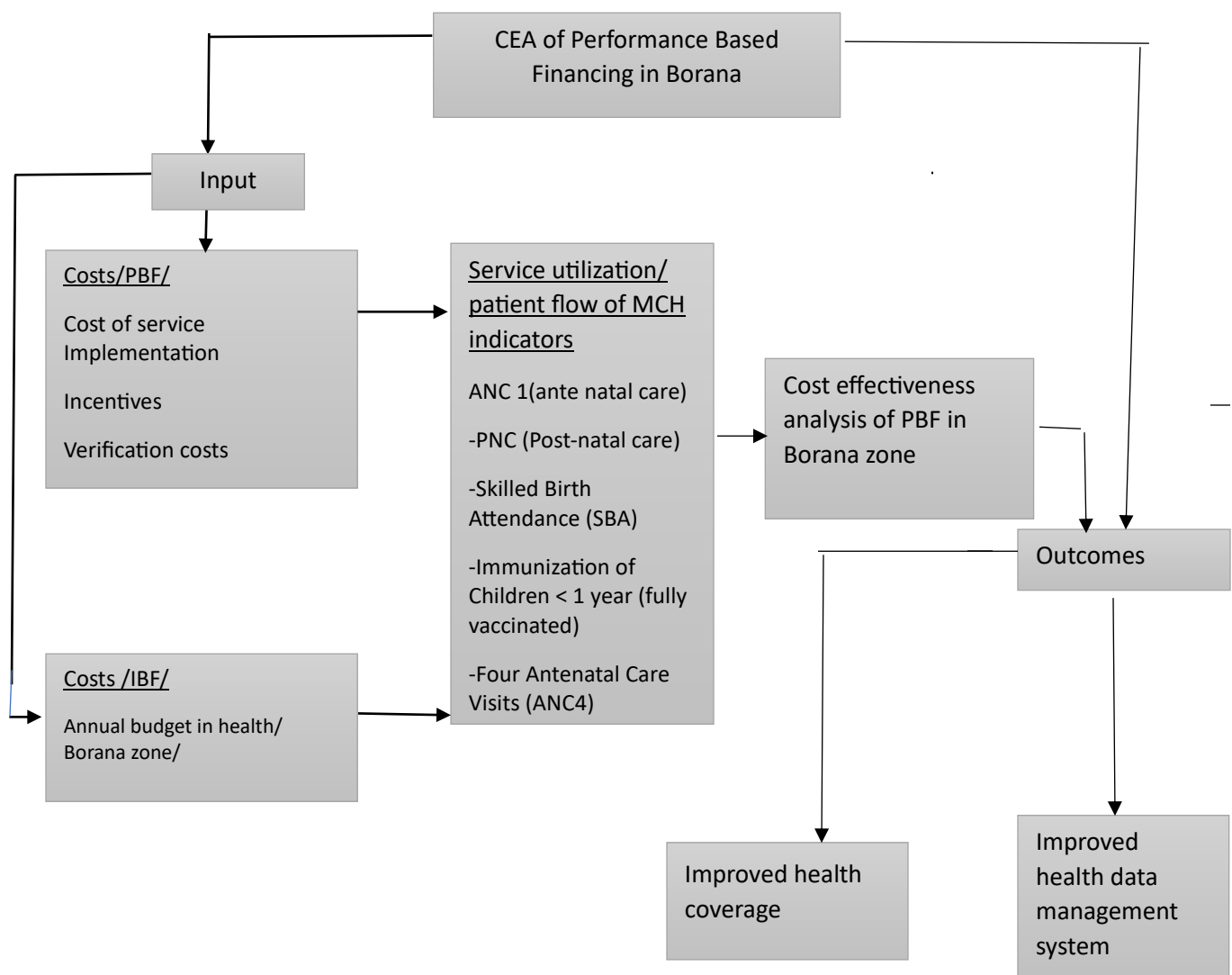
Cost effectiveness analysis of PBF program was also studied in LMICs such as Afghanistan, Tanzania, Nigeria, Zambia, Zimbabwe, and DOC (Democratic Republic of Congo) showing different findings in different contexts (24).

Afghanistan implemented a PBF intervention on a large scale aiming to improve MCH services. Although the intervention resulted in an improvement in the quality of MCH services in the PBF group, the study found that this initiative was unlikely to be cost-effective from a provider payer's perspective(13). In Zimbabwe RBF a very cost-effective intervention for strengthening MCH services(20). In Nigeria the results showed that it was a highly cost effective in improving MCH services(19). In Malawi It was found to be a cost-effective intervention to improve quality of maternal and perinatal healthcare and outcomes, compared with the non-RBF based approach (25). In Zambia, the findings showed that the PBF program in comparison with the control group, is a cost effective approach to improving maternal and child health (21). In DOC (Democratic Republic of Congo) it was found to be cost effective intervention (26) which was also the case in Haiti (27).

3. Conceptual Framework

The conceptual framework shows the relationship between independent variables are the cost of implementing selected MCH services and the outpatient service utilization in health facilities supported by the PBF program in Borana with the dependent variable that is the health outcomes achieved through these services, measured by indicators such as ANC1, ANC 4+ visits, SBA, PNC, and immunization coverage. The main outcome of interest is the cost-effectiveness of the PBF intervention in enhancing the coverage, quality, and impact of MCH services in the Borana Zone

Figure 1: Conceptual framework



4. Objectives of the study

4.1 General objective

The general objective of this study was to do cost effectiveness analysis on performance-based financing (PBF) on maternal and child health outcomes in Borana Zone

4.2 Specific objectives

- To calculate incremental costs of implementing PBF in MCH (maternal and child health) services in Borana Zone
- To determine the DALY's averted by implementation of PBF in Borana Zone
- To estimate the ICER (incremental cost effectiveness ratio) of implementing PBF per DALY's averted in Borana Zone

5. Methodology

5.1 Study Setting and period

This study was conducted in Borana zone, Ethiopia. It was selected because it implementing Performance Based Financing (PBF) under technical and financial assistant of CORDAID with the funds from Embassy of kingdom of Netherland (EKN) with the support of MOH and ORHB with a main focus on the improvement of maternal and child health services.

The program in Borana zone in 2015 started with a population of 780,966 which fully scaled up in 2021 covering all 13 woredas/districts

The study was a retrospective cost effectiveness analysis study of Borana zone from January 2022 to December 2022.

The study period for this paper was from September 2024 to March 2025.

5.2 Study Design

The study used quasi experimental research design to evaluate the cost effectiveness of implementing PBF in the utilization and coverage of MCH services in pastoralist region of Borana zone.

5.3 Study population

The study population included women (mothers) and under 5 children who has visited and/or received treatment at the selected PBF implementing health facilities over the study period

The criteria for inclusion of study was women in the reproductive age group (15-45), pregnant women, newborns and under 5 children who are part the national immunization program. In addition this study focused on the service utilization of the five selected MCH indicators which are ANC1 (1 antenatal care visit), ANC4 (Four antenatal care visits), PNC (Post Natal Care), Skilled Birth Attendance (SBA), Vaccination and the associated cost of delivering of each these services.

The exclusion criteria was health services or other health indicators included in the PBF program and cost of health services not related to maternal and child care were also excluded.

5.4 Sampling Method and sampling size determination

A stratified random sampling approach was used to sample health centers across 13 woreda's of Borana Zone. Each woreda was treated as a distinct stratum to ensure the reflection of geographic variations between them and because there is variability of health facilities between urban and rural areas.

The estimated proportion of health facilities was then adjusted for the finite population of facilities using the finite population correction formula, reducing the risk of overestimating the sample size when the population is relatively small. STATA version 12 was then applied to randomly select woredas from each stratum.

A sample proportion of the health facilities for all regions using single proportion formula

$$n = \frac{Z^2 \times p \times (1-p)}{E^2}$$

Where n is the initial sample size,

Z = corresponding to the desired 95% confidence level (=1.96)

P = estimated proportion of the health centers /Hospitals

E = is the margin of error (typically set at 0.05).

After applying the finite population correction to initial sample size n , the final sample size for health facilities was determined to be adjusted sample size which is estimated as

$$n_{adj} = \frac{n}{1 + \left(\frac{n-1}{N}\right)}$$

Where, N is the number of health centers (Hospital or health center) in each Woreda

For Borana region having 13 woredas, 55 health facilities (50 health center and 5 hospitals) which are under PBF program with catchment population of 1,402,530 the sample size was calculated as 4 hospitals and 35 health centers.(Appendix A)Shows detailed steps of calculating the sample size.

5.5 Quantitative Data collection

5.5.1 Cost data collection

Secondary data on health outcomes and program costs of MCH intervention for Borana was obtained from PBF project accounts, PBF financial reports, DHIS. In this study the cost included will be financial costs of implementing PBF program and economic cost such as staff time and time lost due to productivity will not be included for a main reason the CEA on PBF concentrates on stakeholders such as donors, government (MOH) and NGOs (CORDAID) and other reason being due to lack of tacking system for resources used at each level of PBF implementation.

This study will be using a top down costing approach from health provider perspective regardless of the payer which accounts for the full cost of delivering the MCH interventions for the reason that conducting CEA as objective tool for allocating scarce resources and for the same reasons this paper assesses financial costs. The implementation cost includes in this study are summarized in **Table 1**. The costs that were included were financial cost for the year 2022 January to December)

Table 1. List of PBF expenditure costs

Operational costs
Direct Staff costs
PBF payments/ Incentives
Verification costs
Trainings and workshops
Cost of consumables
Drug and Supply Cost

The incentive costs are tied separately for each MCH indicator but other costs such as operational cost, direct staff cost, verification cost, training and workshops, cost of consumables and drug and supply was divided with all indicators.

The annual health budget of standard health care which is the standard Input Based Financing of Borana zone was gathered from annual financial reports from Oromia Health Bureau (OHB). Standard care health outcomes was gathered from Ethiopia Mini Demographic Health Survey and previous literatures.

5.5.2 Health Outcomes data collection

PBF interventions are being monitored using data from the Health Management Information System (HMIS) and quarterly verified by comparing reported visits with those noted in the health facility registers. The payments were weighted according to the quality of care and quantity assessed by a quarterly score. For this study we focused on the quantity or the rate of utilization of services.

For this study we have chosen 5 indicators of MCH That are ANC, ANC4, PNC, SBA and Vaccination to assess the CEA for reason that PBF focuses in improving the utilization and coverage of MCH services. In addition, this selected services/interventions are part the SPECTRUM software more specifically Lives Saved Tool (LiST) which will use in the analysis to assess the impact and coverage of the services.

Table 2: Performance Based Financing core quantity indicators for MCH services

No	Maternal and Child Health indicators for CEA
1	Four Antenatal Care Visits (ANC4)
2	ANC
3	Skilled Birth Attendance
4	Immunization of Children < 1 year (fully vaccinated)
5	PNC

5.6 Operational definitions

Health Indicator: are the selected health a specific measuring the outcomes of maternal and child health (MCH) services in the context of PBF.

Total Catchment Population: the estimate population of women in the reproductive age group/Estimated deliveries in Oromia region.

Maternal and Child Health Services (MCH): this services in this study include antenatal care (ANC), delivery by skilled birth attendants, postnatal care (PNC), child immunizations at public health facilities participating in the PBF program.

Verification cost: refers to the total financial resources spent on activities related to the validation of reported maternal and child health (MCH) service data under the PBF program.

Intervention effectiveness: is the degree to which the PBF program achieves its intended improvements in MCH outcomes. In this study, it is measured by the increase in the utilization and quality of selected services relative to baseline that is standard input based financing.

5.7 Data Management

The collected secondary data, including service utilization records, cost reports, and health outcomes, were reviewed for completeness, consistency, and accuracy before analysis. Data from various sources such as the regional health bureau, implementing partners, and the national health information system were consolidated in Microsoft Excel and later imported into STATA version 12 for further analysis.

All numeric entries were cross-checked against source documents to identify and correct discrepancies. Outliers and missing values were managed using predefined rules, and data cleaning was conducted prior to any calculations.

5.8 Data analysis

5.8.1 Costing Analysis

All costs were measured in Euro over the period of the program implementation 2022 with inflation rate of 3% which is suggested in multiple guidelines for the purpose of comparability across different studies and interventions (28).

We will adjust the past cost to present value using cost inflation adjusted formula:

$$\text{Adjusted cost}_{2024} = \text{cost in base year}_{2022} \times (1 + r)^n$$

Where,

Adjusted cost-cost adjusted to the present year.

Cost in base year- cost from the past year that you want to inflate.

r- Inflation rate which is 3%

n- Number of years from the base year to the current year.

After adjusting and inflating the cost to year 2024 we will generate annual cost per capita the annual cost per capita is the total cost of the PBF intervention divided by the population served by the intervention. After we calculate the incremental cost of implementing PBF will be calculated as the difference PBF costs per capita and control costs per capita which is the usual care.

5.8.2 Intervention effectiveness and health impact analysis

For Intervention effectiveness and health impact analysis we converted MCH service utilization or coverage of the five selected services to live saved using LiST (Lives Saved Tool) of the SPECTRUM software.

We first obtained the average monthly utilization rate of the selected health services and by using regional estimates we will convert it to coverage using

$$\text{Coverage} = \left(\frac{\text{Total service utilization}}{\text{Total cathment population}} \right) \times 100$$

The total catchment population for the above formula is the estimate population of women in the reproductive age group/Estimated deliveries in Oromia region.

The next step in converting the coverage of the chosen MCH service indicators to lives saved. To do that we will use LiST (Lived Saved Tool) in SPECTRUM software. This tool is used to project the health impact of multiple intervention and specially interventions on MCH health outcomes.

LiST is a tool which is already loaded with country specific statistics based on multiple internal literatures. It will combines national inputs on age-specific population size, disease incidence prevalence and mortality to calculate the number of maternal and neonatal lives saved for a given set of interventions at a specified increase in coverage.

This software will also need additional manual data inputs such as demographic projection of PBF implementing region, current and future plans intervention coverage to calculate and determine the impact of specific neonatal and maternal deaths associated with diseases/conditions from the baseline coverage and lastly generate the number of lives saved which will be converted into DALY's averted.

The final output from LiST is the number of lives saved in each health intervention which should be converted into QALY's gained or the DALY's averted. In our study we will measure the DALY's averted.

For our analysis we converted the Lives saved generated from the Lives Saved Tool to Disability adjusted life year (DALY's) using the formula:

$$DALYs\ Averted = (1 - DW) * \frac{1 - e^{-r(L-a)}}{r}$$

Where, DW derived from global burden of disease of 0.34

e is Napier's mathematical constant (2.718...)

r is discount rate, which is often 3%,

L is life expectancy at the age of death (a)

After estimating the DALY's averted per life saved for each population group which is pregnant women or children under 5, we estimated the total DALY's averted due to PBF by multiplying it with the lives saved which will give us the DALY's averted in each intervention (ANC1, 4ANC, PNC, Skilled Birth attendance, Vaccination).

Lastly the DALY's averted per capita will be estimated for the population covered under PBF.

Based on the cost estimation and health outcome measures we should be able to calculate ICER of Borana zone

ICER= Incremental cost if PBF/ DALY's averted

We will be determining the ICER of the Implementing PBF and Borana, Ethiopia and will compare it to the standard input based financing mechanism.

5.9 Results dissemination plan

The finding of this study will be submitted and presented to Addis Ababa University College of Health Science, School of Public Health and CORDAID. The result will also, disseminated through publication on Addis Ababa University Digital library research catalogue page. It will also be submitted to respective health institutions and other concerned bodies working on health financing.

5.10 Ethical Considerations

Ethical clearance will be obtained from Institutional Review Board of the College of Health Sciences, Addis Ababa University. Before the start of data collection from the organization (CORDAID) they will be informed about the purpose of the study and written and oral informed consent will be taken. The right to refuse or withdraw from the interview will be respected. Information provided will be kept confidential and will not be shared with any third party with the exception to the advisors for this study.

6. Result

The results are presented in 4 sections. The first part consists of the characteristics of the samples regions. The second part consist of the cost of implementing PBF compared to the standard care treatment. The third section consists of the health coverage of PBF as compared to the standard care and the Daly's averted. The fourth section consists of the cost effectiveness analysis which is ICER per Daly's averted by comparing PBF and standard care.

6.1 Characteristics of participants

In order to select the sample, a stratified two-stage sample design was implemented by using a combination of stratified random sampling and proportionate sampling. Health facilities were grouped by region, with a sample size proportionate to the number of facilities in each region. STATA version 12 was then applies for random sampling of the health facilities. This approach ensured that the sample accurately reflects the distribution of health facilities across different regions, enhancing the representativeness of the findings.

The study was conducted in Borana included 38 health facilities (34 health centers and 4 hospitals). **Table 3** shows the summary of the health facilities selected for cost effectiveness analysis. The source for the total population of different woredas were obtained from CSA (Central Statistics Agency) 2022.

Table 3: Summary of the health facilities for Borana Zone

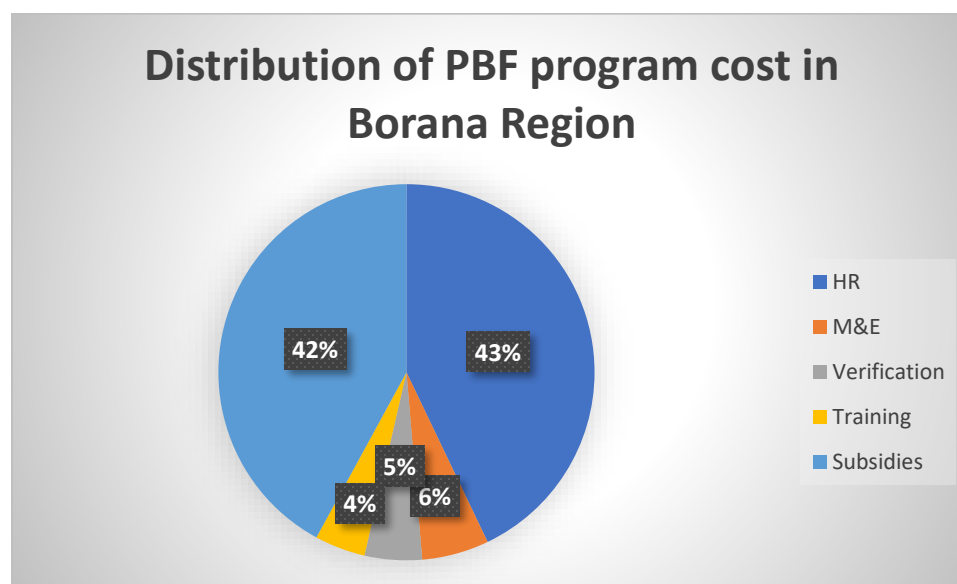
Borana Woredas		Total Population	Sample	Health Facility	Health Facility Catchment Population
1	Gomole Woreda	112341	2	Tula Wayu	14,850
2	Yabelo-Wereda	154643	4	Yabelo HC	28,192
				Har Wayu	11,717
				Dida-Yabelo	24,435
				Dika HC	9691
3	Arero-Wereda	69309	3	Arero PH	47,322
				Halona HC	13,944
				Mata Gafrasa	34,172
4	Dire Woreda	106761	3	Magado HC	5,919
				Soda HC	18,333
				Mega PH	26,356
5	Teltele Woreda	101846	4	Bule Korma	11,606
				Dibe Gaya	14,766
				Kulcha	28,440
				Milami	24,052
6	Elwaye Woreda	99876	3	Chari Rufayi	5,611
				Seba HC	3,409
				Horbate HC	10,887
				Elwaye HC	15,990
7	Dubluki Woreda	102141	3	Bokosa HC	6,448
				Dubluk HC	17,725
				Gobso HC	2,444
8	Meyo Woreda	73413	3	Melbana HC	14,089
				Meti HC	14,029
				Gombisa HC	7,270
				Hidi Lola	20,928
9	Wachile Wereda	69309	2	Webi HC	14,075
10	Moyale Woreda	393573	3	Moyale PH	10,472
				Mado HC	14,385
				Afura HC	11,332
				Tuka HC	10,472
11	Das Woreda	43559	3	Das HC	7,093
				Gayo HC	2,935
				Gorile HC	6,330
12	Dilo Woreda	105678	3	Kancharo HC	7,351
				Hobok HC	2,205
13	Guchi Woreda	209712	3	Mega PH	26,356
				Irdar HC	7,545

6.2 Cost of implementing PBF versus the standard care

Over the total duration of the project in 2022 a total cost of implementing PBF in Borana zone was 1,123,933Euro after applying inflation rate of 3% over the two years i.e. 2022 and 2023 the inflated cost in 2024 was calculated to be 1,157,651 or 2.08 per capita per year. This costs included financial costs such as operational costs, monitoring and evaluation costs, technical assistance, training cost, verification cost which had to be proportionated amongst the all the 24 indicators but incentive costs were tied to each indicator or health outcome.

The breakdown of the yearly PBF expenses showed that human resource was major source of cost which amounted to 274,365 and following that was cost of incentive payment which accounted for 268,992 for the achievement of predetermined of quality and quantity outcomes. The of the PBF implementation cost is summarized in **Figure 2**.

Figure 2: Cost Summary of PBF implementation costs for Borana Zone



For the standard care the total annual budget of 2022 for the Borana was 9,901,476Euro, after applying inflation rate of 3% over the two years i.e. 2022 and 2023 the inflated cost in 2024 was calculated to be 10,197,519 Euro. Costs were annualized by using average exchange rate for Euro for the year 2022.

Table 4: Cost Expenditure summary PBF versus the standard care in 2022.

Expenditure summary(Euro)	Performance Based Financing	Input Based Financing
Total Health Expenditure (Euro)	1,157,651	10,197,519
Catchment population	553,378	553,378
Per capita expenditure	2.08	18.4

6.3 Health coverage impact of lives saved and DALY's averted

The highest number of service utilization rate amongst the MCH services selected for this study was seen in ANC1 and SBA. The yearly service utilization of rate for ANC1, ANC4, PNC, SBA and Vaccination were 14000, 12169, 10512, 9285 and 6402 with coverage rate of 78, 65.4, 56, 51 and 41.2 respectively.

Comparing the Coverage of the MCH services which are under PBF with the standard input based financing the additional number of lives saved was 228 mothers comparing it to the standard input based financing which is 10 Lives saved.

Table 5: Health statistics data on health coverage PBF Vs standard care

Intervention	Coverage under IBF	Coverage under under PBF
ANC1	74	78
ANC4	43	65.4
SBA	48	56
PNC	34	51
Vaccination	44	41.2

6.4 Cost Effectiveness analysis

Cost effectiveness analysis was computed from the cost per DALY's averted which was 8735 for PBF and 383.for Standard input based financing. Furthermore the result shows cost per Daly's averted for PBF was 132.8 Euro and 2660 Euro under the input based financing. The results from

this analysis showed that PBF is a cost minimizing approach as compared to the input based financing.

7. Discussion

Our analysis of this study showed that PBF implementation of the 5 services ANC1, ANC4, PNC, SBA and Vaccination in Borana region was a cost effective when compared to the standard care in improving maternal and child health. The results showed that the cost of MCH services were 1,157,651 and 10,197,519 with a cost per capita of 2.08 and 18.4 for PBF and input based financing respectively. The cost per capita attributed to PBF expenditures in Borana was found to be significantly less when compared with evidences gathered from studies in other SSA(30).

The largest health coverage increase compared to the status quo was seen in ANC4 and the least was in vaccination. The data source of this study being secondary data there was some null data found in the vaccination utilization in few health centers that could have possibly attributed to the low numbers.

The results also showed that the cost per DALY's averted which was 8735 for PBF and 383 for Standard input based financing. The analysis of cost effectiveness using DALY's over Quality Adjusted Life Year was preferred for this study for major reason of DALY capturing mortality and morbidity and are more suited for LMIC's than QALY's which widely in high income countries with focus on health related quality of life.

It is clear that effective health interventions during pregnancy, child birth and post-partum period is proved to have significant outcome in reducing maternal and child mortality. This study Cost effectiveness analysis of PBF in MCH services in Borana has showed that it is an effective program with positive outcomes in health of young women and children. A gradual increase in the utilization of the MCH services was also seen throughout the duration of the study period being minor leap towards accelerated progress towards achieving UHC of HSTP II main objective.

This study showed results that are consistent with other studies done in LMIC's such as Zimbabwe, Nigeria, Zambia, Rwanda and Haiti that proving that PBF was cost effective approach. Similar to our study most of this cost spent on the PBF was associated incentive payments to the health

service provider for achievement of predetermined health outcome and secondly it was operational costs. The study done in Democratic Republic of Congo which was on a higher scale not only involving MCH but includes all services under PBF showed project incremental cost-effectiveness ratio was \$52.40 per DALY's averted(28). The study done in Zimbabwe also showed PBF being a cost effective intervention where the study involved a larger scale inclusive of 16 PBF implementing regions with around 3.46 million inhabitants that showed net annual cost of 2.32\$ per capita when compared to our study having 2.08\$ per capita with a population almost one third of Zimbabwe's(20).

In some countries a variable outcomes was noticed such as in Nigeria which showed it was cost effective and there was a significant increase in SBA and with little to no improvement in vaccination (19). Also in Rwanda it showed there a significant improvement in under 5 malnutrition reported cases, increased institutional delivery and perinatal follow, in addition it is one of the few countries who have fully scaled up the program nationwide due to the positive outcomes in MCH (29).

However now all countries had same positive outcome. In countries like Afghanistan PBF implementation in services such as ANC, PNC and SBA not cost effective. It had increased the service utilization and quality of the MCH services which could be attributed to motivation of the health workers through incentives but this incentives could not address the resource constraints and also lack of financial autonomy to procure some of limited resources locally to tackle it(13). In Zambia, health workers had significant autonomy in addressing the shortage of essential inputs in health facilities by using the incentives were also the program was found to cost effective(27).

Comparing our findings to the PBF study done in Jimma, Ethiopia main drivers were PBF incentive costs and operational cost. The per capital cost expenditure for PBF and standard care was 3 and 15.9 which giving us a little higher values compared to our findings which is 2.08 and 18.4 respectively. Other finding was there was additional 261 lives saved due to the services improvement under PBF compared to which is more maternal and child lives saved compared to our study which was 228(11). In addition our finding also showed cost per DALY's averted to be 132 Euro under PBF and 2600 Euro under IBF which makes the cost associated with the program much less than Jimma which was 637 USD .

8. Strength and Limitation of study

The strength of this study demonstrates that there could be space for PBF as one means of health financing in Ethiopia because the results has shown us positive outcomes in MCH health coverage in addition to being cost effective.

The limitations of this study is that there was lack of Woreda/district level health service data of the standard care and health outcome for the interventions of interest in this study which are ANC1, ANC4, PNC, SBA and Vaccination so we had to use Subnational estimates to calculate the coverage,to feed into the Lives Saved Tool (LiST) .

Another limitation is this study having to use secondary data source there was some data missing on the utilization of vaccinations missing in some quarters in few health centers which certainly affected the results of vaccination coverage being comparatively low to the other services.

In addition other interventions that could currently be implemented in that region for the improvement of MCH that were not captured may have a spillover effect on the health system performance in which this study did not capture.

9. Conclusion

The cost per capita of implementing PBF in Borana, Ethiopia was found to be significantly low when compared to the input based financing and other SSA nation. Also increase in the utilization and coverage of maternal and child health enhances the health system and service delivery. This makes PBF one feasible financing mechanism for the country in the possibility of future scale up of the program.

10. Recommendation

It is clear from our finding the positive outcomes in increase in the utilization of the MCH services through PBF and the program being cost effective which is consistent with the studies done in other regions of Ethiopia such as Jimma zone making this evidence to policy makers and MOH for the potential benefits of the scale up of the program.

Continuous training and capacity building for data collectors, health providers and IT team for ensuring a reliable record keeping, reporting and keeping track of data which is relevant for making accurate cost effective assessments.

In addition, it is obvious that cost effectiveness is an important tool in prioritizing health interventions, however it should not be the only consideration in the selection of interventions for implementation in especially in low income country such as Ethiopia where there is high out of pocket health expenditure. The priority setting process should also consider other socially desirable goals and major health system objectives such as equity and financial risk protection (28). For example, In Ethiopia Out of pocket payment is about 30.54% of the total health financing and larger than the global average which is 21% considerations on implementing programs that are not only cost effective but also minimize financial catastrophe from access to health care should be considered.

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Annex

Annex 1: Participant information

Study Title: Comparing the Cost effectiveness of Performance Based Financing in maternal and child health in Borana, Jimma and West Gojjam

Investigator: Zeweter Temesgen M.D

Advisor: Meseret Molla PhD

Sponsor: Addis Ababa University

Purpose of research: We will be conducting a research study to compare the cost effectiveness of performance-based financing in maternal and child health services across three zones where PBF is being implemented namely at Borana, Jimma and West gojjam. We will be calculating the incremental cost effectiveness ratio (ICER), which is the difference in costs divided by the difference in outcomes (DALY's) of the three regions on MCH service indicators. In order to do this, we would like to request your participation in providing us with information about the costs associated with the project.

Procedure: If you agree to participate, you will be asked to provide information about the costs incurred during the project related to maternal and child health services. This may include information about the cost of design and implementation costs, monitoring and evaluation costs, administrative costs, technical assistance costs and incentive payments for maternal and child service indicators related to the project in three regions

Benefits: This study will help us better understand the costs associated with performance-based financing in maternal and child health services and provide evidence-based recommendations for optimizing the design and the implementation of PBF intervention on MCH services

Incentives: There will not be any incentives for participation in the study.

Confidentiality: Any information collected from the organization for this research will be kept confidential. All data will be kept secured and will not be revealed to anyone except the principal investigator and advisor

Participant right: You have full right to refuse from participating from this research if you don't wish to participate.

Person to contact: If you have any questions or concerns, please do not hesitate to contact

Zeweter Temesgen 

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Email: zowitemesgen4991@gmail.com

Annex 2: Informed consent

We are doing research on comparing the cost effectiveness of performance-based financing (PBF) in improving maternal and child health outcomes in three regions of Ethiopia: Borana, Jimma and West Gojjam. This study involves comparing the cost effectiveness of performance-based financing in maternal and child health services across Borana zone, Jimma zone and West Gojjam zones in Ethiopia. If you agree to participate, you will be asked to provide information about the costs incurred during the project related to maternal and child health services. Your participation in this research is entirely voluntary. It is your choice whether to participate or not. The data collected for this research with anyone. The information that we collect from this research project will be kept entirely confidential.

Certificate of Consent

I have read the foregoing information and I have had the opportunity to ask questions about it and any questions that I have asked have been answered to my satisfaction. I consent voluntarily participation to provide the necessary information required for this research.

Participant on behalf of _____

Signature on behalf of _____

Date _____

Annex 3: Steps to sample size calculation

For Borana region having 13 woredas, 55 health facilities (50 health center and 5 hospitals) which are under PBF program with catchment population of 1,402,530 the sample size will be calculated as 4 hospitals and 35 health centers.

Proportion of hospital (P_1) = 5/55=0.090

$$n_1 = \frac{1.96^2 \times 0.0909 \times (1-0.0909)}{0.05^2} = \frac{3.8416 \times 0.0909 \times 0.9091}{0.0025} = 112.1$$

And applying finite population where N_h is total number of hospitals

$$n_{adj\ 1} = \frac{n_1}{1 + \frac{n_1 - 1}{N_h}} = \frac{112.1}{1 + \frac{112.1 - 1}{5}} = \frac{112.1}{23.42} = 4.8$$

Proportion of health centers (P_2) = 50/55=0.9091

$$n_2 = \frac{1.96^2 \times 0.9091 \times (1-0.9091)}{0.05^2} = \frac{3.8416 \times 0.9091 \times 0.0909}{0.0025} = 112.6$$

And applying finite population where N_c is 50

$$n_{adj} = \frac{112.6}{1 + \frac{112.6 - 1}{50}} = \frac{112.6}{3.235} = 34.8$$

