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Cost of Maternal Health Services in Low- and Middle-Income Countries: Protocol for a Systematic Review

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TITLE:

Cost of Maternal Health Services in Low- and Middle-Income Countries: Protocol for a Systematic Review

AUTHORS:

Aduragbemi Banke-Thomas [1*], Ibukun-Oluwa Omolade Abejirinde [2], Oluwasola Banke-Thomas [3], Adamu Maikano [4], Charles Ameh [5]

[1]Department of Health Policy, London School of Economics and Political Science, London, UK
[2] Department of Public Health, Health Systems Unit, Institute of Tropical Medicine, Antwerp, Belgium
[3] Southwest Interdisciplinary Research Centre, Arizona State University, Phoenix, Arizona, USA
[4] Department of Prevention and Community Programmes, APIN Public Health Initiatives, Abuja, Nigeria
[5] Centre for Maternal and Newborn Health, Liverpool School of Tropical Medicine, Liverpool, UK

NAME AND POSTAL ADDRESS OF CORRESPONDING AUTHOR:

Aduragbemi Banke-Thomas
Department of Health Policy,
London School of Economics and Political Science,
London, WC2A 2AE, UK
Telephone: +44 (0)207 107 5132
Email: a.banke-thomas@lse.ac.uk

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Abstract

Introduction There is substantial evidence that maternal health services across the continuum of care are effective in reducing morbidities and mortalities associated with pregnancy and childbirth. There is also general agreement on the need to invest in the delivery of these services as part of a global goal to achieve Universal Health Coverage. However, there is limited evidence on the costs of providing these services. At a time when emphasis is being placed on demonstrating the value-for-money of health interventions, such information has become critical. This protocol describes the methods and analytical framework to be used in conducting a systematic review of costs associated with providing maternal health services in low- and middle-income countries (LMICs).

Methods: Multiple peer-reviewed and grey literature databases will be searched for relevant articles which report primary costs data for maternal health service in LMICs published after year 2000. This search will be conducted without implementing any language restrictions. Two reviewers will independently search, screen, and select articles that meet the inclusion criteria, with disagreements resolved by discussions with a third reviewer. Quality assessment of included articles will be done using relevant costs data criteria of the Consolidated Health Economic Evaluation Reporting Standards checklist. For comparability, where feasible, costs data will be converted to International dollar equivalents using purchasing power parity conversion factors. Costs associated with providing each maternal health service will be systematically compared. Where heterogeneity in methods or findings are observed, narrative synthesis will be used to summarise findings.

Ethics and dissemination: As this review is based on already published data and does not involve interaction with human subjects, no ethical approval will be required. The plan for

dissemination, however, is to publish the findings of the review in a peer-reviewed journal and present findings at high-level conferences that engage the most pertinent stakeholders.

Trial registration number: PROSPERO_CRD42018114124

KEY WORDS:

Maternal health; ante-natal care; skilled birth attendance; emergency obstetric care; post-natal care; family planning; cost; systematic review; low- and middle-income countries

Strengths and limitations of this study

- To the best of our knowledge, this protocol provides a detailed description of the first systematic review on cost of maternal health services conducted since year 2000.
- The protocol adheres to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses-Protocols guidelines for reporting a systematic review protocol.
- The protocol is being conducted by a multi-disciplinary team with experience conducting similar cost-based systematic reviews.
- Possibility that not all relevant costing studies of maternal health services will be retrieved, especially those in the grey literature.

Introduction

In September 1990, world leaders gathered at the United Nations General Assembly to launch the Millennium development Goals (MDGs), one of which focused on improving maternal health (Goal 5). This goal aimed to reduce maternal mortality ratio (MMR) by three quarters, between 1990 and 2015. Despite concerted efforts which led to a 44% global reduction in MMR by the end of the MDG era, 303,000 women still die every year due to complications associated with pregnancy and childbirth,[1] with 99% of these occurring in low- and middle-income countries (LMICs). In addition, 2.6 million babies die before they are born (50% of them in the third trimester) and 2.7 million die within the first month of life.[2] There is evidence to the effectiveness of critical care packages (antenatal care (ANC), skilled birth attendance, Emergency Obstetric Care (EmOC) (including injectable antibiotics, injectable oxytocics, injectable anticonvulsants, manual removal of placenta, removal of retained products, assisted vaginal delivery, basic neonatal resuscitation, caesarean section and blood transfusion), post-natal care (PNC) and family planning) in reducing maternal and newborn mortality.[3–8] More so, when combined and integrated as a continuum of care package.[9,10]

In addition to the extensive literature on the effectiveness of these care packages, there is also wide consensus on the economic benefits of investing in maternal health services across the continuum of care, especially as healthier women and their children contribute to more productive and sustainable societies.[10–12] However, there is limited data on cost of providing the services in LMICs. Tools such as the WHO-CHOICE (CHOosing Interventions that are Cost Effective) have attempted to collect costs estimates for health services more broadly.[13,14] However, it is not devoid of its flaws, as it is based on predictions made from

modelling of primary and secondary data. Furthermore, WHO-CHOICE does not capture all costs related to maternal health services, such as cost of medicines, and the costs covered are not specific for maternal health.[15] Use of robust country-specific data collected from representative populations are therefore preferred for costing health services,[16] more so maternal health services.[17]

To efficiently and effectively provide maternal health services, skilled health workers, functional equipment, adequate medicines and supplies are required, all of which have attributable costs, whether they are provided in public, private or mission hospitals. Despite low gross domestic product (GDP) per capita income in LMICs (defined by the World Bank as <US$3,385 in July 2018),[18] governments traditionally provide the majority of funding required for maternal health services with private and third sector organisations (including non-governmental organisations, charities and missionaries) complementing service provision in LMICs. Women using the services on the other hand also have some costs associated with their use of the services. Costs which is sometimes inhibitive to access to critical maternal health services for women living in LMICs.[19]

Data on costs of these services are needed to complement the already established effectiveness data and aid conduct of cost-effectiveness and value-for-money (VfM) studies more broadly.[20] Such data will also feed into priority setting and resource allocation for maternal health in LMICs. The only previous review that has been conducted was published in year 2000 and included papers published mostly in the 1990s.[17] In the Sustainable Development Goals (SDGs) era, where competition for limited resources is high, evidence on costs of providing maternal health services will be central to informing policy and

practice.[20,21] The aim of this review is to assess the costs associated with maternal health services in LMICs from available evidence in the peer-reviewed and grey literature. To achieve this aim, the following research questions were developed:

- What is the scope of evidence on cost of maternal health services in LMICs?
- What is the cost of maternal health services (ANC, skilled birth attendance, EmOC, PNC and family planning) in LMICs?
- How have such costs data been collected and analysed in the existing body of literature?
- What cost items were reported for the different maternal health services in the published studies?
- What are the similarities and differences in costs of providing maternal health services in LMICs?

Methods and analysis

Protocol registration

This protocol is registered in the PROSPERO database (CRD42018114124). In designing the proposed methods for the review, we leveraged best practices for conducting systematic reviews on costs and cost-effectiveness of interventions from the Centre for Reviews and Dissemination and the Task Force on Community Preventive Services.[22,23] The protocol adheres to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses for Protocols 2015 (PRISMA-P 2015).[24] (online supplementary material S1)

Study design

A systematic review of peer review and grey literature following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) approach by Moher et al. [25] is planned for this review. Figure 1 summarises the planned stages of the review as described in this protocol.

Literature search

We will search multiple databases: African Journal Online, CINAHL Plus, EconLit, Embase, Global Health Archive, Google Scholar, LILACS, Popline, PubMed, SciELO, Scopus, the Cochrane Library, and Web of Knowledge. In searching, we will combine medical subject headings (MeSH) and/or key words, using Boolean linkages "OR" within categories and "AND" between three groups of words and phrases that capture the interventions, costs and the setting of interest (LMICs). Table 1 shows the summary of the search strategy that will be adapted for the various databases. The combination of these search terms guarantees an optimal search strategy for retrieving cost and economic studies relevant to maternal health services.[26]

The websites of governments, non-government organisations, UN agencies, and institutions that we know may have done costing of maternal health services from our experience will be searched to identify relevant grey literature. Specifically, we will search websites of LMIC Ministries of Health, Population Council, Averting Maternal Death and Disability, Guttmacher Institute, FP2020, Maternal Health Task Force, United Nations Children's Fund, United Nations Fund for Population and World Health Organization. In addition to the automated search, we will search for other relevant articles by reviewing the reference lists of retrieved

articles. If a study is found in the grey literature, which was later published in the peer-reviewed literature, the peer-reviewed version will be selected for the review.

For both peer-reviewed and grey literature sources, the search will be focused on retrieving articles published from January 2000 to December 2018, as the costs data after this period are deemed to be more current and relevant for planning services in the SDG era. No limit will be placed on language in our search.

Selection of studies

Two co-authors (ABT and IOA) will independently conduct the search and screen all retrieved records. Titles and abstracts will be screened for relevance and eligibility, based on the set inclusion/exclusion criteria (defined below). If titles or abstracts appear relevant, full-text will be subsequently reviewed to verify relevance of study for the review. Full-texts of retrieved articles will be stored in shared folders within an automated reference manger, Mendeley Desktop© version 1.19.2 (Elsevier B.V., Amsterdam, Netherlands) for easy access for the review team. Any discrepancies regarding the relevance of studies for the review will be resolved through discussions with the senior co-author (CA). Reasons for decisions taken as regards inclusion or exclusion of studies will be documented. The inclusion/exclusion processes will also be reported as per the PRISMA reporting guidelines for systematic reviews.[25]

Inclusion and exclusion criteria

Articles published in the peer-review or grey literature after year 2000 will be included if these present primary data on cost of any of the maternal health services collected from one or

multiple LMIC(s), as defined by the World Bank.[18] Commentaries, editorials, letters that only broadly discuss cost of providing maternal health services as well as other reviews will be excluded. In addition, articles will be excluded if the services costed are provided by individuals who are not legally allowed to provide such services in the specific country. In addition, articles will not be included if they include lump costs that cannot be disaggregated into service categories (ANC, skilled birth attendance, EmOC, PNC and family planning).

Data extraction

We will use two pre-developed Microsoft Excel© (Microsoft Corporation, Redmond, U.S.) forms focused on quality assessment and evidence synthesis to extract data for this review. For all included articles, we will collect data on the article description (authors, year of publication, article title, journal), study setting (country of study, country of organisation conducting study, characteristics of women receiving maternal health services who were surveyed or for whom costs data were collected, perspective of costing (health system, government or societal), study design (cost analysis, partial economic evaluation, full economic evaluation or nested in another study), costing of maternal health services (intervention(s) costed, costing method used (top-down/bottom-up), time frame, facility type (health centre, hospital), facility ownership (private, public or mission), number of facilities, component of cost included (for example, cost of labour, equipment, medicines, supplies and for those who do, opportunity cost[27]), year of costs data, currency and discount rate) as well as findings reported (including total service cost estimates per time period or where reported, cost per client visit). For articles which take a societal perspective and report cost of utilising services, we will collect non-health facility related costs such as transport.

Guidance on costs data to be collected were sought from previous review and expert opinion.[17,28]

Data extraction will be conducted independently by two of the co-authors (ABT and IOA) independently and then checked for accuracy by a third reviewer (OBT).

Handling missing data

In cases where data is missing from articles and not publicly available, we will make attempts to contact the study authors directly via contact information provided in the study or report, or by using portals such as ResearchGate and LinkedIn. If efforts do not yield required data to allow study to meet inclusion criteria for the review, such study will be excluded and reason for exclusion provided.

Quality assessment of included studies

The 24-item Consolidated Health Economic Evaluation Reporting Standards (CHEERS) checklist is typically used for assessing quality of reporting of the full economic evaluations.[29] However, as many of the studies that will be included in this review may be purely cost analyses, which are a form of partial economic evaluations,[27] only the relevant criteria in the CHEERS checklist will be used in this review. This choice is based on quality assessments used in similar reviews that focused on costing.[30] Specifically for this review, quality criteria to be used for assessment will include completeness of the title and abstract (or executive summary in the case of grey literature reports), clarity on the broad context for the study and study question, description of characteristics of the population, costs perspective used and time horizon, description of methods used to estimate costs, report on

dates of the estimated costs and unit costs as well as methods used in converting costs into a common currency base and the exchange rate. In addition, the review will assess presentation of key study findings including detailed breakdown of costs incurred, description of how conclusions were reached, discussion of study limitations and the generalisability of the findings and how the findings fit with current knowledge.[28,29]

For each item, a score of 1 will be awarded if the criterion is fully met, 0.5, if partially met, 0, if not met or if only minimal information was provided, and NA if not applicable. The total score achieved across all the criteria will be subsequently summed-up and converted to percentages. As has been done in other similar reviews,[30,31] studies with 75% or more criteria fully met will be classified as high quality, 50-74% as average quality and below 50% as poor quality. Each included study will be assessed independently by two co-authors (ABT and MA).

Data synthesis

Characteristics of included studies will be summarised, and cost data provided by the authors will be collated. The different costs items associated with each service (medicines and supplies, equipment, and labour costs) will be identified. Opportunity costs will be excluded before totalling the direct financial cost of each service, as not all costing studies typically include it.[30] To allow ease of cost comparisons, purchasing power parity (PPP) conversion factors[32] will be used to convert local currency of the country in which the study was conducted to International Dollar (I$) equivalents for the reported year of cost data collection.[33] Costs reported in US dollars using 'market exchange rates' will first be converted to local currency for the year the costing was done, using official OANDA exchange

rates before being converted to I$ using PPP factors.[34] PPP, as opposed to market exchange rates, allows hypothetical estimation of the amount it would cost to purchase the same market basket of goods in various countries, if their currencies were at par.[33] Based on these newly calculated I$ equivalents, the unit cost per service will be calculated. At the end, we will compare costs from each country and try to explain the reasons for any observed similarities and differences. Where we find that it will not be possible to pool some findings together due to methodological heterogeneity, we will conduct a narrative synthesis of the available information.

Ethics and dissemination

As this review is based on already published data and does not involve interaction with human subjects, no ethical approval will be required. The plan for dissemination however is to publish the findings of the review in peer-reviewed journal and present findings at high-level international conferences that engage the most pertinent stakeholders. The proposed systematic review will provide detailed summary of available evidence on costs maternal health services across the continuum of care and will complement evidence from modelled costing analysis conducted to estimate projected costs of achieving the SDG targets in LMICs.[35] Clearly, in the era of the SDGs, the renewed commitment to reduce MMR to 70 deaths per 100,000 live births globally and ensure that “no one is left behind” including in terms of receiving critical health care,[36] require up-to-date information on the costs associated with these services. This systematic review will be a one-stop shop for such data.

Footnotes

Contributors: ABT, OBT and CA conceived the review design. IOA refined the review design. ABT drafted the initial manuscript. All authors were involved in subsequent draft manuscript reviews and updates and approved the final version of this protocol.

Competing interests: None declared.

Patient consent: Not required.

Provenance and peer review: Not commissioned; externally peer reviewed.

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Tables

Table 1: Search terms to be adapted for use in the different databases for the review

Search term category	Specific search term
Intervention	"ante*natal care" OR ANC OR "birth" OR "skilled birth attendance" OR "obstetric emergenc*" OR "emergency obstetric care" OR "emergency obstetric and newborn care" OR EmOC OR EmONC OR "caesarean*" OR "vacuum" OR "post*natal care" OR "PNC" OR obstetric OR newborn OR delivery OR maternity OR "family planning" OR contraception
Cost	"cost*" OR "cost of care" OR "cost*analysis" OR "cost*effectiveness" OR "cost*utility" OR "cost*benefit" OR "economic evaluation"
Setting of interest	"Low-and-Middle-Income Countr*", "low income countr*", "Africa", "sub-Saharan Africa", "Asia", Afghanistan, Angola, Bangladesh, Benin, Bhutan, Bolivia, Botswana, "Burkina Faso", Burundi, "Cabo Verde", Cambodia, Cameroon, "Central African Republic", Chad, Comoros, "Democratic Republic of Congo", Congo, "Côte d'Ivoire", Cuba, Djibouti, Egypt, "El Salvador", "Equatorial Guinea", Eritrea, Ethiopia, Fiji, Gabon, Gambia, Georgia, Ghana, Guinea, Guinea-Bissau, Guyana, Haiti, Honduras, India, Indonesia, Iran, Iraq, Jamaica, Kazakhstan, Kenya, Kiribati, "Democratic People's Republic of Korea", Kosovo, Kyrgyzstan, "Lao People's Democratic Republic", Lebanon, Lesotho, Liberia, Libya, Madagascar, Malawi, Maldives, Mali, Mauritania, Micronesia, Moldova, Mongolia, Morocco, Mozambique, Myanmar, Namibia, Nauru, Nepal, Nicaragua, Niger, Nigeria, Pakistan, Palau, Panama, "Papua New Guinea", Paraguay, Peru, Philippines, Rwanda, "São Tomé and Príncipe", Senegal, Serbia, "Sierra Leone", "Solomon Islands", Somalia, "South Africa", "South Sudan", "Sri Lanka", Sudan, Swaziland, "Syrian Arab Republic", Tajikistan, Tanzania, Thailand, Timor-Leste, Togo, Tokelau, Tonga, Tunisia, Uganda, Ukraine, Uzbekistan, Vanuatu, Venezuela, Vietnam, "Wallis and Futuna", "West Bank and Gaza Strip", Yemen, Zambia, Zimbabwe

Figure titles

Figure 1: Summary of search strategy search process

Online supplementary materials

File name: Online supplementary material S1
File format: docx.
Title of data: Completed PRISMA-P checklist
Description of data: Completed Preferred Reporting Items for Systematic Reviews and Meta-Analyses for Protocols 2015 checklist

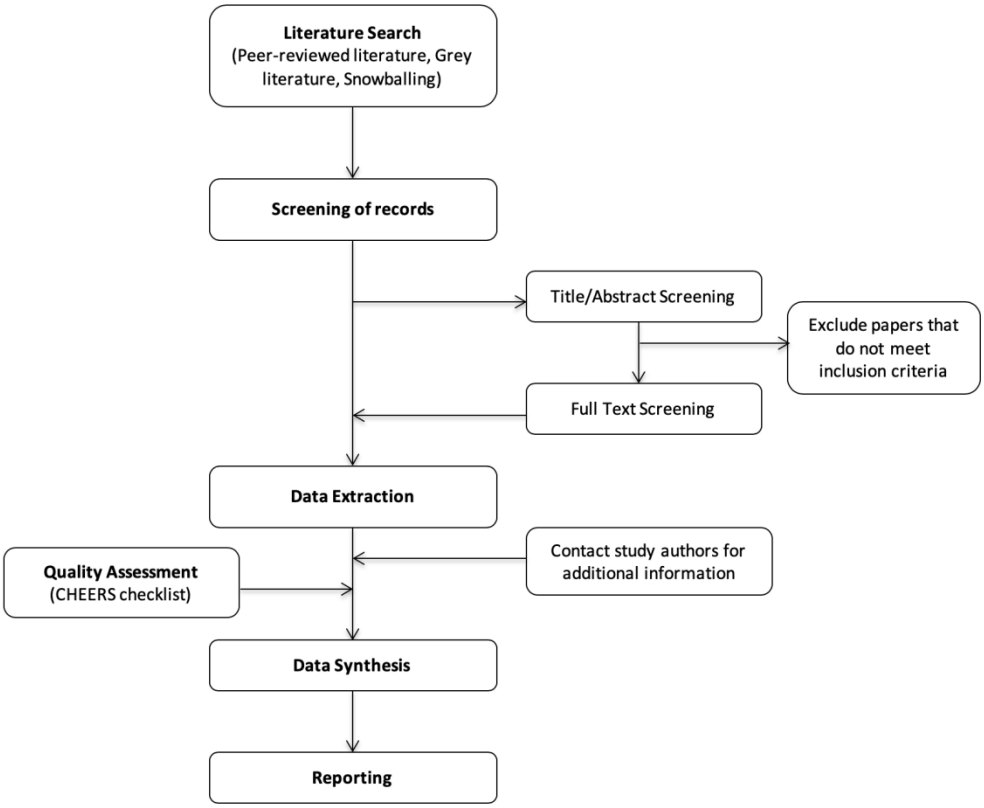

Figure 1: Summary of search strategy search process

PRISMA-P checklist: *Cost of Maternal Health Services in Low- and Middle-Income Countries: Protocol for a Systematic Review – Banke-Thomas et al. 2018*

Checklist #	Checklist item	Achieved	Verification
1a	Identify the report as a protocol of a systematic review.	Yes	Stated in the title
1b	If the protocol is for an update of a previous systematic review, identify as such.	N/A	
2	If registered, provide the name of the registry (e.g., PROSPERO) and registration number.	Yes	PROSPERO Reg. #: CRD42018114124
3a	Provide name, institutional affiliation, and e-mail address of all protocol authors; provide physical mailing address of corresponding author.	Yes	Achieved in Title page.
3b	Describe contributions of protocol authors and identify the guarantor of the review.	Yes	Article footnote.
4	If the protocol represents an amendment of a previously completed or published protocol, identify as such and list changes; otherwise, state plan for documenting important protocol amendments.	N/A	
5a	Indicate sources of financial or other support for the review.	N/A	
5b	Provide name for the review funder and/or sponsor.	N/A	
5c	Provide name for the review funder and/or sponsor.	N/A	
6	Describe the rationale for the review in the context of what is already known.	Yes	Introduction
7	Provide an explicit statement of the question(s) the review will address with reference to participants, interventions, comparators, and outcomes (PICO).	Yes	Introduction
8	Specify the study characteristics (e.g., PICO, study design, setting, time frame) and report characteristics (e.g., years considered, language, publication status) to be used as criteria for eligibility for the review.	Yes	Methods and analysis
9	Describe all intended information sources (e.g., electronic databases, contact with study authors, trial registers, or other grey literature sources) with planned dates of coverage.	Yes	Methods and analysis
10	Present draft of search strategy to be used for at least one electronic database, including planned limits, such that it could be repeated.	Yes	Table 1
11a	Describe the mechanism(s) that will be used to manage records and data throughout the review.	Yes	Methods and analysis
11b	State the process that will be used for selecting studies (e.g., two independent reviewers) through each phase of the review (i.e., screening, eligibility, and inclusion in meta-analysis.	Yes	Methods and analysis
11c	Describe planned method of extracting data from reports (e.g., piloting forms, done independently, in duplicate), any processes for obtaining and confirming data from investigators.	Yes	Methods and analysis
12	List and define all variables for which data will be sought (e.g., PICO items, funding sources), any pre-planned data assumptions and simplifications.	Yes	Methods and analysis
13	List and define all outcomes for which data will be sought, including prioritization of main and additional outcomes, with rationale.	N/A	
14	Describe anticipated methods for assessing risk of bias of individual studies, including whether this will be done at the outcome or study level, or both; state how this information will be used in data synthesis.	N/A	
15a	Describe criteria under which study data will be quantitatively synthesized.	Yes	Methods and analysis
15b	If data are appropriate for quantitative synthesis, describe planned summary measures, methods of handling data, and methods of combining data from studies, including any planned exploration of consistency.	Yes	Methods and analysis
15c	Describe any proposed additional analyses (e.g., sensitivity or subgroup analyses, meta-regression).	Yes	Methods and analysis
15d	If quantitative synthesis is not appropriate, describe the type of summary planned.	Yes	Methods and analysis
16	Specify any planned assessment of meta-bias(es) (e.g., publication bias across studies, selective reporting within studies).	Yes	Methods and analysis
17	Describe how the strength of the body of evidence will be assessed (e.g., GRADE).	Yes	Methods and analysis

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Cost of Maternal Health Services in Low- and Middle-Income Countries: Protocol for a Systematic Review

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AUTHORS:

Aduragbemi Banke-Thomas [1*], Ibukun-Oluwa Omolade Abejirinde [2], Oluwasola Banke-Thomas [3], Adamu Maikano [4], Charles Ameh [5]

[1]Department of Health Policy, London School of Economics and Political Science, London, UK
[2] Department of Public Health, Health Systems Unit, Institute of Tropical Medicine, Antwerp, Belgium
[3] Southwest Interdisciplinary Research Centre, Arizona State University, Phoenix, Arizona, USA
[4] Department of Prevention and Community Programmes, APIN Public Health Initiatives, Abuja, Nigeria
[5] Centre for Maternal and Newborn Health, Liverpool School of Tropical Medicine, Liverpool, UK

NAME AND POSTAL ADDRESS OF CORRESPONDING AUTHOR:

Aduragbemi Banke-Thomas
Department of Health Policy,
London School of Economics and Political Science,
London, WC2A 2AE, UK
Telephone: +44 (0)207 107 5132
Email: a.banke-thomas@lse.ac.uk

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Abstract

Introduction There is substantial evidence that maternal health services across the continuum of care are effective in reducing maternal and newborn morbidities and mortalities. There is also consensus regarding the need to invest in the delivery of these services towards the global goal of achieving Universal Health Coverage in low- and middle-income countries (LMICs). However, there is limited evidence on the costs of providing these services. This protocol describes the methods and analytical framework to be used in conducting a systematic review of costs of providing maternal health services in LMICs.

Methods: Multiple peer-reviewed databases including African Journal Online, CINAHL Plus, EconLit, Embase, Global Health Archive, Popline, PubMed and Scopus as well as grey literature will be searched for relevant articles which report primary costs data for maternal health service in LMICs published from January 2000 to June 2019. This search will be conducted without implementing any language restrictions. Two reviewers will independently search, screen, and select articles that meet the inclusion criteria, with disagreements resolved by discussions with a third reviewer. Quality assessment of included articles will be done using relevant costs data criteria of the Consolidated Health Economic Evaluation Reporting Standards checklist. For comparability, where feasible, cost will be converted to International dollar equivalents using purchasing power parity conversion factors. Cost associated with providing each maternal health services will be systematically compared, using a sub-group analysis. Where heterogeneity in methods or findings are observed, narrative synthesis will be used. Population contextual and intervention design characteristics that help achieve cost-savings and improve efficiency of maternal health service provision in LMICs will be identified.

Ethics and dissemination: Ethical approval is not required for this review. The plan for dissemination is to publish review findings in a peer-reviewed journal and present findings at high-level conferences that engage the most pertinent stakeholders.

Trial registration number: PROSPERO_CRD42018114124

KEY WORDS:

cost; economic; low- and middle-income countries; maternal health; systematic review protocol

Strengths and limitations of this study

- To the best of our knowledge, this protocol provides a detailed description of the first systematic review on cost of maternal health services conducted since year 2000.
- The protocol adheres to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses-Protocols guidelines for reporting a systematic review protocol.
- The protocol is being conducted by a multi-disciplinary team with experience conducting similar cost-based systematic reviews.
- Possibility that not all relevant costing studies of maternal health services will be retrieved, especially those in the grey literature.

INTRODUCTION

In September 1990, world leaders gathered at the United Nations General Assembly to launch the Millennium Development Goals (MDGs), one of which focused on improving maternal health (Goal 5). This goal aimed to reduce maternal mortality ratio (MMR) by three quarters, between 1990 and 2015. Despite concerted efforts which led to a 44% global reduction in MMR by the end of the MDG era, 303,000 women still die every year due to complications associated with pregnancy and childbirth,[1] with 99% of these occurring in low- and middle-income countries (LMICs). In addition, 2.6 million babies die before they are born (50% of them in the third trimester) and 2.7 million die within the first month of life.[2] The challenge to reduce these preventable deaths remains in the Sustainable Development Goals (SDGs) era in which the target is the reduce MMR to 70 deaths per 100,000 live births globally.[3,4]

There is evidence to the effectiveness of critical care packages (antenatal care (ANC), skilled birth attendance, Emergency Obstetric Care (EmOC) (including injectable antibiotics, injectable oxytocics, injectable anticonvulsants, manual removal of placenta, removal of retained products, assisted vaginal delivery, basic neonatal resuscitation, caesarean section and blood transfusion), post-natal care (PNC) and family planning) in reducing maternal and newborn mortality.[5–10] More so, when combined and integrated as a continuum of care.[11,12] Definitions of the maternal health services covered in this review are presented in Table 1.

In addition to the extensive literature on the effectiveness of these care packages, there is also wide consensus on the economic benefits of investing in maternal health services across the continuum of care, especially as healthier women and their children contribute to more

productive and sustainable societies.[12–14] Evidence also suggests that maternal health services especially those that are preventive in nature such as ANC are highly cost-effective.[15] However, there is limited data on the cost of providing the services in LMICs. Tools such as the WHO-CHOICE (CHOosing Interventions that are Cost Effective) have attempted to collect costs estimates for health services more broadly.[16,17] This tool is based on predictions made from modelling of primary and secondary data and is not devoid of its flaws. Furthermore, WHO-CHOICE does not capture all costs related to maternal health services, such as the cost of medicines, and the costs covered are not specific for maternal health.[18] Use of robust country-specific data collected from representative populations are therefore preferred for costing health services,[19] more so maternal health services.[20]

To efficiently and effectively provide maternal health services, skilled health workers, functional equipment, adequate medicines and supplies are required, all of which have attributable costs, irrespective of the facility ownership (public, private or mission owned). Despite low gross domestic product (GDP) per capita income in LMICs (defined by the World Bank as <US$3,385 in July 2018),[21] governments traditionally provide the majority of funding required for maternal health services. This is complemented by private and third sector organisations (including non-governmental organisations, charities and missionaries). On the other hand, women using the services also incur costs associated with their use of maternal health services. Costs are often times a barrier for women living in LMICs to access necessary maternal health services.[22]

Data on costs of these services are therefore needed to complement the already established effectiveness data and facilitate the conduct of cost-effectiveness and value-for-money (VfM)

studies more broadly.[23] Such data will also feed into priority setting and resource allocation for maternal health in LMICs. However, a preliminary search of PubMed, Scopus, Embase, Cochrane database, Joanna Briggs Institute (JBI) Database of Systematic Reviews and Implementation Reports, and PROSPERO to identify systematic reviews that had been conducted on this topic area revealed only one previous review. The identified previously conducted review was published in the year 2000 and included papers published mostly in the 1990s.[20] In the SDG era, where competition for limited resources is high, evidence on the cost of providing maternal health services will be central to informing policy and practice.[4,23] The objective of this review is to assess the costs associated with maternal health services in LMICs from available evidence in the peer-reviewed and grey literature. To achieve this objective, the following research questions were developed:

1. What are the costs associated with the provision of maternal health services in low- and middle-income countries?

   1a. What cost items for various maternal health services have been reported in the literature?

   1b. How have such cost data been collected and analyzed in the existing body of literature?

   1c. What are the similarities and differences in the cost of providing maternal health services in LMICs?

2. What lessons can be learnt from different cost-saving techniques used in providing maternal health services in low- and middle-income countries?

METHODS

Protocol registration

This protocol is registered in the PROSPERO database (CRD42018114124). In designing the proposed methods for the review, we leveraged best practices for conducting systematic reviews on costs and cost-effectiveness of interventions from the Centre for Reviews and Dissemination and the Task Force on Community Preventive Services.[24,25] The protocol adheres to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses for Protocols 2015 (PRISMA-P 2015).[26] (see online supplementary material S1)

Patient and public involvement

Patients and the public were not involved in the design of this systemic review protocol.

Study design

A systematic review of peer review and grey literature following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) approach by Moher et al. [27] is planned for this review. Figure 1 summarises the planned stages of the review as described in this protocol.

Data source and search strategy

A preliminary search was conducted on 2nd January 2019 to test the pre-designed search strategy. A repeat search will be conducted 30th June 2019 to bring our review up to date before publication and ensure that no recent relevant articles will be missed. We will search multiple databases: African Journal Online, CINAHL Plus, EconLit, Embase, Global Health

Archive, Popline, PubMed, and Scopus. In searching the various databases, and where relevant, we will combine medical subject headings (MeSH) and/or keywords, using Boolean linkages "OR" within categories and "AND" between three groups of words and phrases that capture the interventions, costs and the setting of interest (LMICs). Table 2 shows a summary of the search strategy that will be adapted for the various databases. The combination of these search terms guarantees an optimal search strategy for retrieving cost and economic studies relevant to maternal health services,[28] and has been developed with support from our institutional librarian. Through the entire process of its development, we used the McGowan et al.'s checklist to assess the adequacy of our electronic search strategy.[29] Search results from the implementation of our search strategy as implemented in Scopus is presented as part of this protocol (see online supplementary material S2).

The websites of governments, non-government organisations, UN agencies, and institutions that we know may have done costing of maternal health services from our experience will be searched to identify relevant grey literature. Specifically, we will search Google Scholar, websites of LMIC Ministries of Health, Population Council, Averting Maternal Death and Disability, Guttmacher Institute, FP2020, Maternal Health Task Force, United Nations Children's Fund, United Nations Fund for Population and World Health Organization. In addition to the automated search, we will search for other relevant articles by reviewing the reference lists of retrieved articles. If a study is found in the grey literature, which was later published in the peer-reviewed literature, the peer-reviewed version will be selected for the review.

For both peer-reviewed and grey literature sources, the search will be focused on retrieving articles published from January 2000 to June 2019, as the costs data after this period are deemed to be more current and relevant for planning services in the SDG era. The search will be limited to studies published in English and French languages, which the authors understand. This search will be conducted independently by two authors (ABT and IOA), with search results compared for completeness.

Selection of studies

Two co-authors (ABT and IOA) will independently screen all retrieved records. Titles and abstracts will be screened for relevance and eligibility, based on the set inclusion/exclusion criteria (defined below). If titles or abstracts appear relevant, full-text will be subsequently reviewed to verify the relevance of the study for the review. Full-texts of retrieved articles will be stored in shared folders within an automated reference manager, Mendeley Desktop© version 1.19.2 (Elsevier B.V., Amsterdam, Netherlands) for easy access for the review team. Any discrepancies regarding the relevance of studies for the review will be resolved through discussions with the senior co-author (CA). Reasons for decisions taken as regards inclusion or exclusion of studies will be documented. The inclusion/exclusion processes will also be reported as per the PRISMA reporting guidelines for systematic reviews.[27]

Eligibility criteria

Inclusion criteria

Full (cost minimization, cost-effectiveness, cost-utility and cost-benefit analyses) and partial (cost analysis, cost-description studies and cost-outcome studies) economic evaluations of any or a combination of the maternal health services captured along the continuum of care

(ANC, skilled birth attendance, EmOC (including injectable antibiotics, injectable oxytocics, injectable anticonvulsants, manual removal of placenta, removal of retained products, assisted vaginal delivery, basic neonatal resuscitation, caesarean section and blood transfusion), PNC and family planning) will be considered in this review. Articles published in the peer-review or grey literature after year 2000 will be included if these present primary data on cost of any of the maternal health services provided to women regardless of the level of care (primary, secondary or tertiary levels) and collected from one or multiple LMIC(s), as defined by the World Bank.[21] Studies published year 2000 onwards are deemed most relevant for the post-2015 era of the SDGs.

Exclusion criteria

Commentaries, editorials, letters that only broadly discuss the cost of providing maternal health services, as well as other reviews, will be excluded. In addition, articles will be excluded if the maternal health services are provided by individuals who are not legally allowed to provide such services in the country of study based on published national policy guidelines.

Quality assessment of included studies

The 24-item Consolidated Health Economic Evaluation Reporting Standards (CHEERS) checklist has typically been used for assessing the quality of reporting of the full economic evaluations.[30] However, as many of the studies that will be included in this review may be purely cost analyses, which are a form of partial economic evaluations,[31] only the relevant criteria in the CHEERS checklist will be used in this review. This choice is based on quality assessments used in similar reviews that focused on cost.[32]

Specifically for this review, quality criteria to be used for assessment will include completeness of the title and abstract (or executive summary in the case of grey literature reports), clarity on the broad context for the study and study question, description of characteristics of the population, costs perspective used and time horizon, description of methods used to estimate costs, report on dates of the estimated costs and unit costs as well as methods used in converting costs into a common currency base and the exchange rate. In addition, the review will assess presentation of key study findings including a detailed breakdown of costs incurred, description of how conclusions were reached, discussion of study limitations and the generalisability of the findings and how the findings fit with current knowledge.[30,33]

For each item, a score of 1 will be awarded if the criterion is fully met, 0.5, if partially met, 0, if not met or if only minimal information was provided, and NA if not applicable. The total score achieved across all the criteria will be subsequently summed-up and converted to percentages. As has been done in other similar reviews,[32,34] studies with 75% or more criteria fully met will be classified as high quality, 50-74% as average quality and below 50% as poor quality. Each included study will be assessed independently by two co-authors (ABT and MA).

Data extraction

We will use two pre-developed Microsoft Excel© (Microsoft Corporation, Redmond, U.S.) forms focused on quality assessment and evidence synthesis to extract data for this review. For all included articles, we will collect data on the article description (authors, year of publication, article title, journal), study setting (country of study, country of organisation

conducting study, characteristics of women receiving maternal health services who were surveyed or for whom costs data were collected, perspective of costing (health system, government or societal), study design (cost analysis, partial economic evaluation, full economic evaluation or nested in another study), costing of maternal health services (intervention(s) costed, costing method used (top-down or expenditure approach that involves breaking down total cost into component costs (C_{Total}=>C_1+C_2+C_3) vs. bottom-up or ingredient approach that involves building-up the component/ingredient cost to estimate the total cost (C_1 +C_2+C_3 =>C_{Total})), time frame, facility type (health centre, hospital), facility ownership (private, public or mission), number of facilities, component of cost included (for example, start-up cost, running cost, cost of labour, equipment, medicines, supplies and for those who do, opportunity cost[31] etc.), year of costs data, currency and discount rate) as well as findings reported (including total service cost estimates per time period or where reported, cost per client visit). For articles which take a societal perspective and report the cost of utilising services, we will collect non-health facility-related costs such as transport. Guidance on costs data to be collected were sought from a previous review[20] and an expert opinion.[33]

Data extraction will be conducted independently by two of the co-authors (ABT and IOA) independently and then checked for accuracy by a third reviewer (OBT). To minimize inconsistency between reviewers, we will conduct training and calibration exercises using the data extraction form prior to the commencement of the systematic review. In cases where data is missing from articles and not publicly available, we will make attempts to contact the study authors directly via the contact information provided in the study or report, or by using portals such as ResearchGate and LinkedIn.

Data synthesis

Characteristics of included studies will be summarised, and cost data provided by the authors will be collated. Using a sub-group analysis, the different costs items associated with each service (medicines and supplies, equipment, and labour costs) will be identified. Articles that include lump costs that cannot be disaggregated into service categories (ANC, skilled birth attendance, EmOC, PNC and family planning) will be analysed separately. Opportunity costs will be excluded before totalling the direct financial cost of each service, as not all costing studies typically include it.[32] Comparison of service costs across countries will be performed. To allow ease of cost comparisons, purchasing power parity (PPP) conversion factors[35] will be used to convert the local currency of the country in which the study was conducted to International Dollar (I$) equivalents for the reported year of cost data collection.[36] Costs reported in US dollars using 'market exchange rates' will first be converted to local currency for the year the costing was done, using official OANDA exchange rates before being converted to I$ using PPP factors.[37] PPP, as opposed to market exchange rates, allows hypothetical estimation of the amount it would cost to purchase the same market basket of goods in various countries if their currencies were at par.[36] Based on these newly calculated I$ equivalents, the unit cost per service will be calculated.

Finally, we will compare costs from each country and try to explain the reasons for any observed similarities and differences. Where we find that it will not be possible to pool some findings together due to methodological heterogeneity, we will conduct a narrative synthesis of the available information. In doing this, relevant country-specific issues related to delivering and utilising maternal health services in the individual study countries will be

highlighted and used to explain findings. In addition, in line with global guidance for conducting economic evaluations,[38] efforts will be made to identify the population contextual and intervention design characteristics that help support lower costs (cost-savings) and improve the efficiency of maternal health service provision in LMICs. Furthermore, where possible, we will highlight the major cost drivers in providing maternal health services. These findings will constitute critical lessons that could be transferred from one LMIC to another.

Ethics and dissemination

As this review is based on already published data and does not involve interaction with human subjects, no ethical approval will be required. The plan for dissemination, however, is to publish the findings of the review in a peer-reviewed journal and present findings at high-level international conferences that engage the most pertinent stakeholders. The proposed systematic review will provide a detailed summary of available evidence on costs maternal health services across the continuum of care and will complement evidence from modelled costing analysis conducted to estimate projected costs of achieving the SDG targets in LMICs.[39]

DISCUSSION

This protocol has been rigorously developed and designed specifically to assess the cost of maternal health services in LMICs. Given the limited recent evidence of cost associated with providing these critical services, findings from the review will be critical for researchers, policy-makers, government and non-governmental organisations for planning maternal and newborn health services in LMICs. If protocol modifications are required, the authors will

include the detailed description of any changes along with a justification during the publication of the review.

Clearly, in the era of the SDGs in which the focus is to ensure that "no one is left behind" including in terms of receiving critical health care,[3] require up-to-date information on the costs associated with these services. This systematic review will be a one-stop shop for such data.

Footnotes

Contributors: ABT conceived the review. ABT, OBT and CA designed the review. IOA refined the review design. ABT and AM were involved in the initial drafting of the manuscript. All authors were involved in subsequent draft manuscript reviews and updates and approved the final version of this protocol.

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Tables

Table 1: Definition of key terms

Key terms	Definitions
Antenatal care (ANC)	care provided by skilled health care professionals to pregnant women in order to ensure the best health conditions for both mother and baby during pregnancy.
Skilled birth attendance	delivery by a health professional who can identify and manage normal labor and delivery; and identify and treat complications or provide basic care and referral conducted within an enabling environment.
Emergency obstetric care (EmOC)	care package required to treat complications that arise from pregnancy and childbirth. There are two levels of care (basic and comprehensive). Basic EmOC includes parenteral administration of parenteral antibiotics, uterotonic drugs and parenteral anticonvulsants, manual removal of placenta, removal of retained products, performance of assisted vaginal delivery and neonatal resuscitation. At a higher level of care, comprehensive EmOC includes all Basic EmOC interventions, blood transfusion and caesarean section services.
Postnatal care	care given to the mother and her newborn baby immediately after the birth and for the first six weeks of life.
Family planning services	Services including educational, comprehensive medical or social activities which enable individuals, including minors, to determine freely the number and spacing of their children and to select the means by which this may be achieved (For this review, focus will be on women).

Table 2: Search terms to be adapted for use in the different databases for the review

Search term category	Specific search term
Intervention	"ante*natal care" OR ANC OR "birth" OR "skilled birth attendance" OR "obstetric emergenc*" OR "emergency obstetric care" OR "emergency obstetric and newborn care" OR EmOC OR EmONC OR "caesarean*" OR "vacuum" OR "post*natal care" OR "PNC" OR obstetric OR newborn OR delivery OR maternity OR "family planning" OR contraception
Cost	"cost*" OR "cost of care" OR "cost*analysis" OR "cost*effectiveness" OR "cost*utility" OR "cost*benefit" OR "economic evaluation"
Setting of interest	"Low-and-Middle-Income Countr*", "low income countr*", "Africa", "sub-Saharan Africa", "Asia", Afghanistan, Angola, Bangladesh, Benin, Bhutan, Bolivia, Botswana, "Burkina Faso", Burundi, "Cabo Verde", Cambodia, Cameroon, "Central African Republic", Chad, Comoros, "Democratic Republic of Congo", Congo, "Côte d'Ivoire", Cuba, Djibouti, Egypt, "El Salvador", "Equatorial Guinea", Eritrea, Ethiopia, Fiji, Gabon, Gambia, Georgia, Ghana, Guinea, Guinea-Bissau, Guyana, Haiti, Honduras, India, Indonesia, Iran, Iraq, Jamaica, Kazakhstan, Kenya, Kiribati, "Democratic People's Republic of Korea", Kosovo, Kyrgyzstan, "Lao People's Democratic Republic", Lebanon, Lesotho, Liberia, Libya, Madagascar, Malawi, Maldives, Mali, Mauritania, Micronesia, Moldova, Mongolia, Morocco, Mozambique, Myanmar, Namibia, Nauru, Nepal, Nicaragua, Niger, Nigeria, Pakistan, Palau, Panama, "Papua New Guinea", Paraguay, Peru, Philippines, Rwanda, "São Tomé and Príncipe", Senegal, Serbia, "Sierra Leone", "Solomon Islands", Somalia, "South Africa", "South Sudan", "Sri Lanka", Sudan, Swaziland, "Syrian Arab Republic", Tajikistan, Tanzania, Thailand, Timor-Leste, Togo, Tokelau, Tonga, Tunisia, Uganda, Ukraine, Uzbekistan, Vanuatu, Venezuela, Vietnam, "Wallis and Futuna", "West Bank and Gaza Strip", Yemen, Zambia, Zimbabwe

Figure titles

Figure 1: Summary of search strategy search process

Online supplementary materials

File name: Online supplementary material S1
File format: pdf
Title of data: Completed PRISMA-P checklist
Description of data: Completed Preferred Reporting Items for Systematic Reviews and Meta-Analyses for Protocols 2015 checklist

File name: Online supplementary material S2
File format: pdf
Title of data: Full search strategy implemented in Scopus
Description of data: Full search strategy implemented in Scopus

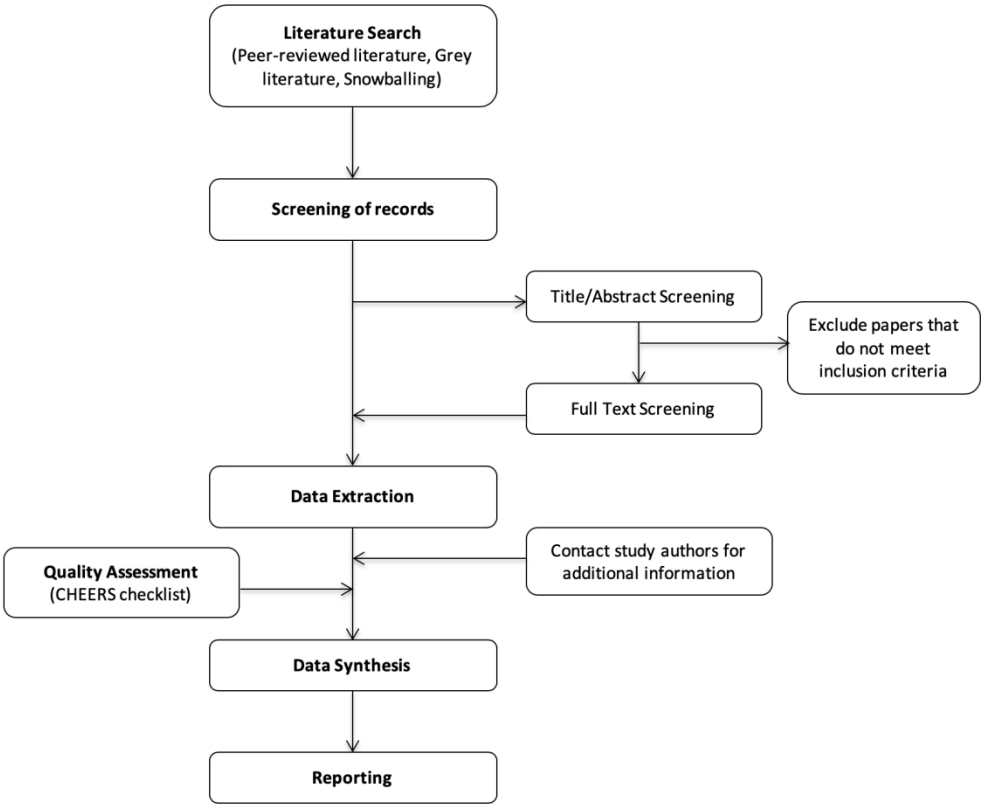

Figure 1: Summary of search strategy search process

PRISMA-P checklist: *Cost of Maternal Health Services in Low- and Middle-Income Countries: Protocol for a Systematic Review – Banke-Thomas et al. 2018*

Checklist #	Checklist item	Achieved	Verification
1a	Identify the report as a protocol of a systematic review.	Yes	Stated in the title
1b	If the protocol is for an update of a previous systematic review, identify as such.	N/A	
2	If registered, provide the name of the registry (e.g., PROSPERO) and registration number.	Yes	PROSPERO Reg. #: CRD42018114124
3a	Provide name, institutional affiliation, and e-mail address of all protocol authors; provide physical mailing address of corresponding author.	Yes	Achieved in Title page.
3b	Describe contributions of protocol authors and identify the guarantor of the review.	Yes	Article footnote.
4	If the protocol represents an amendment of a previously completed or published protocol, identify as such and list changes; otherwise, state plan for documenting important protocol amendments.	N/A	
5a	Indicate sources of financial or other support for the review.	N/A	
5b	Provide name for the review funder and/or sponsor.	N/A	
5c	Provide name for the review funder and/or sponsor.	N/A	
6	Describe the rationale for the review in the context of what is already known.	Yes	Introduction
7	Provide an explicit statement of the question(s) the review will address with reference to participants, interventions, comparators, and outcomes (PICO).	Yes	Introduction
8	Specify the study characteristics (e.g., PICO, study design, setting, time frame) and report characteristics (e.g., years considered, language, publication status) to be used as criteria for eligibility for the review.	Yes	Methods and analysis
9	Describe all intended information sources (e.g., electronic databases, contact with study authors, trial registers, or other grey literature sources) with planned dates of coverage.	Yes	Methods and analysis
10	Present draft of search strategy to be used for at least one electronic database, including planned limits, such that it could be repeated.	Yes	Table 1
11a	Describe the mechanism(s) that will be used to manage records and data throughout the review.	Yes	Methods and analysis
11b	State the process that will be used for selecting studies (e.g., two independent reviewers) through each phase of the review (i.e., screening, eligibility, and inclusion in meta-analysis.	Yes	Methods and analysis
11c	Describe planned method of extracting data from reports (e.g., piloting forms, done independently, in duplicate), any processes for obtaining and confirming data from investigators.	Yes	Methods and analysis
12	List and define all variables for which data will be sought (e.g., PICO items, funding sources), any pre-planned data assumptions and simplifications.	Yes	Methods and analysis
13	List and define all outcomes for which data will be sought, including prioritization of main and additional outcomes, with rationale.	N/A	
14	Describe anticipated methods for assessing risk of bias of individual studies, including whether this will be done at the outcome or study level, or both; state how this information will be used in data synthesis.	N/A	
15a	Describe criteria under which study data will be quantitatively synthesized.	Yes	Methods and analysis
15b	If data are appropriate for quantitative synthesis, describe planned summary measures, methods of handling data, and methods of combining data from studies, including any planned exploration of consistency.	Yes	Methods and analysis
15c	Describe any proposed additional analyses (e.g., sensitivity or subgroup analyses, meta-regression).	Yes	Methods and analysis
15d	If quantitative synthesis is not appropriate, describe the type of summary planned.	Yes	Methods and analysis
16	Specify any planned assessment of meta-bias(es) (e.g., publication bias across studies, selective reporting within studies).	Yes	Methods and analysis
17	Describe how the strength of the body of evidence will be assessed (e.g., GRADE).	Yes	Methods and analysis

Online supplementary material S2: Full search strategy implemented in Scopus

Search conducted	Specific search term and number of records retrieved
Services (Year 2000 onwards)	(TITLE-ABS-KEY ("ante*natal care" OR anc OR "birth" OR "skilled birth attendance" OR "obstetric emergenc*" OR "emergency obstetric care" OR "emergency obstetric and newborn care" OR emoc OR emonc) AND PUBYEAR > 1999) OR (TITLE-ABS-KEY ("caesarean*" OR "vacuum" OR "post*natal care" OR "PNC" OR obstetric OR newborn OR delivery OR maternity OR "family planning" OR contraception) AND PUBYEAR > 1999) 1,585,263 records
Cost (Year 2000 onwards)	TITLE-ABS-KEY (cost* OR "cost of care" OR "cost*analysis" OR "cost*effectiveness" OR "cost*utility" OR "cost*benefit" OR "economic evaluation") AND PUBYEAR > 1999 2,029,490 records
Service AND cost (Year 2000 onwards)	((TITLE-ABS-KEY ("ante*natal care" OR anc OR "birth" OR "skilled birth attendance" OR "obstetric emergenc*" OR "emergency obstetric care" OR "emergency obstetric and newborn care" OR emoc OR emonc) AND PUBYEAR > 1999) OR (TITLE-ABS-KEY ("caesarean*" OR "vacuum" OR "post*natal care" OR "PNC" OR obstetric OR newborn OR delivery OR maternity OR "family planning" OR contraception) AND PUBYEAR > 1999)) AND (TITLE-ABS-KEY (cost* OR "cost of care" OR "cost*analysis" OR "cost*effectiveness" OR "cost*utility" OR "cost*benefit" OR "economic evaluation") AND PUBYEAR > 1999) 112,253 records
Service AND cost (Year 2000 onwards, limited by language)	((TITLE-ABS-KEY ("ante*natal care" OR anc OR "birth" OR "skilled birth attendance" OR "obstetric emergenc*" OR "emergency obstetric care" OR "emergency obstetric and newborn care" OR emoc OR emonc) AND PUBYEAR > 1999) OR (TITLE-ABS-KEY ("caesarean*" OR "vacuum" OR "post*natal care" OR "PNC" OR obstetric OR newborn OR delivery OR maternity OR "family planning" OR contraception) AND PUBYEAR > 1999)) AND (TITLE-ABS-KEY (cost* OR "cost of care" OR "cost*analysis" OR "cost*effectiveness" OR "cost*utility" OR "cost*benefit" OR "economic evaluation") AND PUBYEAR > 1999) AND (LIMIT-TO (LANGUAGE , "English") OR LIMIT-TO (LANGUAGE , "French")) 107,929 records
Service AND cost (Year 2000 onwards, limited by language and country of interest)	((TITLE-ABS-KEY ("ante*natal care" OR anc OR "birth" OR "skilled birth attendance" OR "obstetric emergenc*" OR "emergency obstetric care" OR "emergency obstetric and newborn care" OR emoc OR emonc) AND PUBYEAR > 1999) OR (TITLE-ABS-KEY ("caesarean*" OR "vacuum" OR "post*natal care" OR "PNC" OR obstetric OR newborn OR delivery OR maternity OR "family planning" OR contraception) AND PUBYEAR > 1999)) AND (TITLE-ABS-KEY (cost* OR "cost of care" OR "cost*analysis" OR "cost*effectiveness" OR "cost*utility" OR "cost*benefit" OR "economic evaluation") AND PUBYEAR > 1999) AND (LIMIT-TO (LANGUAGE , "English") OR LIMIT-TO (LANGUAGE , "French")) AND (LIMIT-TO (AFFILCOUNTRY , "India") OR LIMIT-TO (AFFILCOUNTRY , "Iran") OR LIMIT-TO (AFFILCOUNTRY , "Pakistan") OR LIMIT-TO (AFFILCOUNTRY , "Nigeria") OR LIMIT-TO (AFFILCOUNTRY , "Thailand") OR LIMIT-TO (AFFILCOUNTRY , "Kenya") OR LIMIT-TO (AFFILCOUNTRY , "Egypt") OR LIMIT-TO (AFFILCOUNTRY , "Uganda") OR LIMIT-TO (AFFILCOUNTRY , "Bangladesh") OR LIMIT-TO (AFFILCOUNTRY , "Indonesia") OR LIMIT-TO (AFFILCOUNTRY , "Ghana") OR LIMIT-TO (AFFILCOUNTRY , "Tanzania") OR LIMIT-TO (AFFILCOUNTRY , "Ethiopia") OR LIMIT-TO (AFFILCOUNTRY , "Viet Nam") OR LIMIT-TO (AFFILCOUNTRY , "Malawi") OR LIMIT-TO (AFFILCOUNTRY , "Philippines") OR LIMIT-TO (AFFILCOUNTRY , "Nepal") OR LIMIT-TO (AFFILCOUNTRY , "Zambia") OR LIMIT-TO (AFFILCOUNTRY , "Tunisia") OR LIMIT-TO (AFFILCOUNTRY , "Lebanon") OR LIMIT-TO (AFFILCOUNTRY , "Peru") OR LIMIT-TO (AFFILCOUNTRY , "Burkina Faso") OR LIMIT-TO (AFFILCOUNTRY , "Sri Lanka") OR LIMIT-TO (AFFILCOUNTRY , "Morocco") OR LIMIT-TO (AFFILCOUNTRY , "Zimbabwe") OR LIMIT-TO (AFFILCOUNTRY , "Cameroon") OR LIMIT-TO (AFFILCOUNTRY , "Rwanda") OR LIMIT-TO (AFFILCOUNTRY , "Congo") OR LIMIT-TO (AFFILCOUNTRY , "Senegal") OR LIMIT-TO (AFFILCOUNTRY , "Mozambique") OR LIMIT-TO (AFFILCOUNTRY , "Botswana") OR LIMIT-TO (AFFILCOUNTRY , "Mali") OR LIMIT-TO (AFFILCOUNTRY , "Iraq") OR LIMIT-TO (AFFILCOUNTRY , "Cuba") OR LIMIT-TO (AFFILCOUNTRY , "Sudan") OR LIMIT-TO (AFFILCOUNTRY , "Benin") OR LIMIT-TO (AFFILCOUNTRY , "Gambia") OR LIMIT-TO (AFFILCOUNTRY , "Guatemala") OR LIMIT-TO (AFFILCOUNTRY , "Papua New Guinea") OR LIMIT-TO (AFFILCOUNTRY , "Cote d'Ivoire") OR LIMIT-TO (AFFILCOUNTRY , "Jamaica") OR LIMIT-TO (AFFILCOUNTRY , "Afghanistan") OR LIMIT-TO (AFFILCOUNTRY , "Kazakhstan") OR LIMIT-TO (AFFILCOUNTRY , "Madagascar") OR LIMIT-TO (AFFILCOUNTRY , "Panama") OR LIMIT-TO (AFFILCOUNTRY , "Laos") OR LIMIT-TO (AFFILCOUNTRY , "Myanmar") OR LIMIT-TO (AFFILCOUNTRY , "Fiji") OR LIMIT-TO (AFFILCOUNTRY , "Haiti") OR LIMIT-TO (AFFILCOUNTRY , "Moldova") OR LIMIT-TO (AFFILCOUNTRY , "Bolivia") OR LIMIT-TO (AFFILCOUNTRY , "Honduras") OR LIMIT-TO (AFFILCOUNTRY , "Niger") OR LIMIT-TO (AFFILCOUNTRY , "Namibia") OR LIMIT-TO (AFFILCOUNTRY , "El Salvador") OR LIMIT-TO (AFFILCOUNTRY , "Gabon") OR LIMIT-TO (AFFILCOUNTRY , "Sierra Leone") OR LIMIT-TO (AFFILCOUNTRY , "Syrian Arab Republic") OR LIMIT-TO (AFFILCOUNTRY , "Yemen") OR LIMIT-TO (AFFILCOUNTRY , "Uzbekistan") OR LIMIT-TO (AFFILCOUNTRY , "Democratic Republic Congo") OR LIMIT-TO (AFFILCOUNTRY , "Libyan Arab Jamahiriya") OR LIMIT-TO (AFFILCOUNTRY , "Togo") OR LIMIT-TO (AFFILCOUNTRY , "Burundi") OR LIMIT-TO (AFFILCOUNTRY , "Swaziland") OR LIMIT-TO (AFFILCOUNTRY , "Angola") OR LIMIT-TO (AFFILCOUNTRY , "Eritrea") OR LIMIT-TO (AFFILCOUNTRY , "Guinea") OR LIMIT-TO (AFFILCOUNTRY , "Lesotho") OR LIMIT-TO (AFFILCOUNTRY , "Chad")) OR LIMIT-TO (AFFILCOUNTRY , "Undefined")) 12,529 records

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Cost of Maternal Health Services in Low- and Middle-Income Countries: Protocol for a Systematic Review

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TITLE:

Cost of Maternal Health Services in Low- and Middle-Income Countries: Protocol for a Systematic Review

AUTHORS:

Aduragbemi Banke-Thomas [1*], Ibukun-Oluwa Omolade Abejirinde [2], Oluwasola Banke-Thomas [3], Adamu Maikano [4], Charles Ameh [5]

[1]Department of Health Policy, London School of Economics and Political Science, London, UK
[2] Department of Public Health, Health Systems Unit, Institute of Tropical Medicine, Antwerp, Belgium
[3] Southwest Interdisciplinary Research Centre, Arizona State University, Phoenix, Arizona, USA
[4] Department of Prevention and Community Programmes, APIN Public Health Initiatives, Abuja, Nigeria
[5] Centre for Maternal and Newborn Health, Liverpool School of Tropical Medicine, Liverpool, UK

NAME AND POSTAL ADDRESS OF CORRESPONDING AUTHOR:

Aduragbemi Banke-Thomas
Department of Health Policy,
London School of Economics and Political Science,
London, WC2A 2AE, UK
Telephone: +44 (0)207 107 5132
Email: a.banke-thomas@lse.ac.uk

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Abstract

Introduction There is substantial evidence that maternal health services across the continuum of care are effective in reducing morbidities and mortalities associated with pregnancy and childbirth. There is also consensus regarding the need to invest in the delivery of these services towards the global goal of achieving Universal Health Coverage in low- and middle-income countries (LMICs). However, there is limited evidence on the costs of providing these services. This protocol describes the methods and analytical framework to be used in conducting a systematic review of costs of providing maternal health services in LMICs.

Methods: African Journal Online, CINAHL Plus, EconLit, Embase, Global Health Archive, Popline, PubMed and Scopus as well as grey literature databases will be searched for relevant articles which report primary cost data for maternal health service in LMICs published from January 2000 to June 2019. This search will be conducted without implementing any language restrictions. Two reviewers will independently search, screen, and select articles that meet the inclusion criteria, with disagreements resolved by discussions with a third reviewer. Quality assessment of included articles will be conducted based on cost-focused criteria included in globally recommended checklists for economic evaluations. For comparability, where feasible, cost will be converted to International dollar equivalents using purchasing power parity conversion factors. Costs associated with providing each maternal health services will be systematically compared, using a sub-group analysis. Sensitivity analysis will also be conducted. Where heterogeneity is observed, a narrative synthesis will be used. Population contextual and intervention design characteristics that help achieve cost-savings and improve efficiency of maternal health service provision in LMICs will be identified.

Ethics and dissemination: Ethical approval is not required for this review. The plan for dissemination is to publish review findings in a peer-reviewed journal and present findings at high-level conferences that engage the most pertinent stakeholders.

Trial registration number: PROSPERO_CRD42018114124

KEY WORDS:

cost; economic; low- and middle-income countries; maternal health; systematic review protocol

Strengths and limitations of this study

- To the best of our knowledge, this protocol provides a detailed description of the first systematic review on cost of maternal health services conducted since year 2000.
- The protocol adheres to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses-Protocols guidelines for reporting a systematic review protocol.
- The protocol is being conducted by a multi-disciplinary team with experience conducting similar cost-based systematic reviews.
- Possibility that not all relevant costing studies of maternal health services will be retrieved, especially those in the grey literature.

INTRODUCTION

In September 1990, world leaders gathered at the United Nations General Assembly to launch the Millennium Development Goals (MDGs), one of which focused on improving maternal health (Goal 5). This goal aimed to reduce maternal mortality ratio (MMR) by three quarters, between 1990 and 2015. Despite concerted efforts which led to a 44% global reduction in MMR by the end of the MDG era, 303,000 women still die every year due to complications associated with pregnancy and childbirth,[1] with 99% of these occurring in low- and middle-income countries (LMICs). In addition, 2.6 million babies die before they are born (50% of them in the third trimester) and 2.7 million die within the first month of life.[2] The challenge to reduce these preventable deaths remains in the Sustainable Development Goals (SDGs) era in which the target is the reduce MMR to 70 deaths per 100,000 live births globally.[3,4]

There is evidence to the effectiveness of critical care packages (antenatal care (ANC), skilled birth attendance, Emergency Obstetric Care (EmOC) (including injectable antibiotics, injectable oxytocics, injectable anticonvulsants, manual removal of placenta, removal of retained products, assisted vaginal delivery, basic neonatal resuscitation, caesarean section and blood transfusion), post-natal care (PNC) and family planning) in reducing maternal morbidity and mortality.[5–10] More so, when combined and integrated as a continuum of care.[11,12] Definitions of the maternal health services covered in this review are presented in Table 1.

In addition to the extensive literature on the effectiveness of these care packages, there is also wide consensus on the economic benefits of investing in maternal health services across the continuum of care, especially as healthier women and their children contribute to more

productive and sustainable societies.[12–14] Evidence also suggests that maternal health services especially those that are preventive in nature such as ANC are highly cost-effective.[15] However, there is limited data on the cost of providing the services in LMICs. Tools such as the WHO-CHOICE (CHOosing Interventions that are Cost Effective) have attempted to collect costs estimates for health services more broadly.[16,17] This tool is based on predictions made from modelling of primary and secondary data and is not devoid of its flaws. Furthermore, WHO-CHOICE does not capture all costs related to maternal health services, such as the cost of medicines, and the costs covered are not specific for maternal health.[18] Use of robust country-specific data collected from representative populations are therefore preferred for costing health services,[19] more so maternal health services.[20]

To efficiently and effectively provide maternal health services, skilled health workers, functional equipment, adequate medicines and supplies are required, all of which have attributable costs, irrespective of the facility ownership (public, private or mission owned). Despite low gross domestic product (GDP) per capita income in LMICs (defined by the World Bank as <US$3,385 in July 2018),[21] governments traditionally provide the majority of funding required for maternal health services. This is complemented by private and third sector organisations (including non-governmental organisations, charities and missionaries). On the other hand, women using the services also incur costs associated with their use of maternal health services. Costs are often times a barrier for women living in LMICs to access necessary maternal health services.[22]

Data on costs of these services are therefore needed to complement the already established effectiveness data and facilitate the conduct of cost-effectiveness and value-for-money (VfM)

studies more broadly.[23] Such data will also feed into priority setting and resource allocation for maternal health in LMICs. However, a preliminary search of PubMed, Scopus, Embase, Cochrane database, Joanna Briggs Institute (JBI) Database of Systematic Reviews and Implementation Reports, and PROSPERO to identify systematic reviews that had been conducted on this topic area revealed only one previous review. The identified previously conducted review was published in the year 2000 and included papers published mostly in the 1990s.[20] In the SDG era, where competition for limited resources is high, evidence on the cost of providing maternal health services will be central to informing policy and practice.[4,23] The objective of this review is to assess the costs associated with maternal health services in LMICs from available evidence in the peer-reviewed and grey literature. To achieve this objective, the following research questions were developed:

1. What are the costs associated with the provision of maternal health services in low- and middle-income countries?

   1a. What cost items for various maternal health services have been reported in the literature?

   1b. How have such cost data been collected and analyzed in the existing body of literature?

   1c. What are the similarities and differences in the cost of providing maternal health services in LMICs?

2. What lessons can be learnt from different cost-saving techniques used in providing maternal health services in low- and middle-income countries?

METHODS

Protocol registration

This protocol is registered in the PROSPERO database (CRD42018114124). In designing the proposed methods for the review, we leveraged best practices for conducting systematic reviews on costs and cost-effectiveness of interventions from the Centre for Reviews and Dissemination and the Task Force on Community Preventive Services.[24,25] The protocol adheres to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses for Protocols 2015 (PRISMA-P 2015).[26] (see online supplementary material S1)

Patient and public involvement

Patients and the public were not involved in the design of this systemic review protocol.

Study design

A systematic review of peer review and grey literature following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) approach by Moher et al. [27] is planned for this review. Figure 1 summarises the planned stages of the review as described in this protocol.

Data source and search strategy

A preliminary search was conducted on 2nd January 2019 to test the pre-designed search strategy. A repeat search will be conducted 30th June 2019 to bring our review up to date before publication and ensure that no recent relevant articles will be missed. We will search multiple databases: African Journal Online, CINAHL Plus, EconLit, Embase, Global Health

Archive, Popline, PubMed, and Scopus. In searching the various databases, and where relevant, we will combine medical subject headings (MeSH) and/or keywords, using Boolean linkages "OR" within categories and "AND" between three groups of words and phrases that capture the interventions, costs and the setting of interest - LMICs. Table 2 shows a summary of the search strategy that will be adapted for the various databases. The combination of these search terms guarantees an optimal search strategy for retrieving cost and economic studies relevant to maternal health services,[28] and has been developed with support from our institutional librarian. Through the entire process of its development, we used the McGowan et al.'s checklist to assess the adequacy of our electronic search strategy.[29] Search results from the implementation of our search strategy as implemented in Scopus is presented as part of this protocol (see online supplementary material S2).

The websites of governments, non-government organisations, UN agencies, and institutions that we know may have done costing of maternal health services from our experience will be searched to identify relevant grey literature. Specifically, we will search Google Scholar, websites of LMIC Ministries of Health, Population Council, Averting Maternal Death and Disability, Guttmacher Institute, FP2020, Maternal Health Task Force, United Nations Children's Fund, United Nations Fund for Population and World Health Organization. In addition to the automated search, we will search for other relevant articles by reviewing the reference lists of retrieved articles. If a study is found in the grey literature, which was later published in the peer-reviewed literature, the peer-reviewed version will be selected for the review.

For both peer-reviewed and grey literature sources, the search will be focused on retrieving articles published from January 2000 to June 2019, as the costs data after this period are deemed to be more current and relevant for planning services in the SDG era. The search will be limited to studies published in English and French languages, which the authors understand. This search will be conducted independently by two authors (ABT and IOA), with search results compared for completeness.

Selection of studies

Two co-authors (ABT and IOA) will independently screen all retrieved records. Titles and abstracts will be screened for relevance and eligibility, based on the set inclusion/exclusion criteria (defined below). If titles or abstracts appear relevant, full-text will be subsequently reviewed to verify the relevance of the study for the review. Full-texts of retrieved articles will be stored in shared folders within an automated reference manager, Mendeley Desktop© version 1.19.2 (Elsevier B.V., Amsterdam, Netherlands) for easy access for the review team. Any discrepancies regarding the relevance of studies for the review will be resolved through discussions with the senior co-author (CA). Reasons for decisions taken as regards inclusion or exclusion of studies will be documented. The inclusion/exclusion processes will also be reported as per the PRISMA reporting guidelines for systematic reviews.[27]

Eligibility criteria

Inclusion criteria

Full (cost minimization, cost-effectiveness, cost-utility and cost-benefit analyses) and partial (cost analysis, cost-description studies and cost-outcome studies) economic evaluations of any or a combination of the maternal health services captured along the continuum of care

as defined by Kerber et al. 2007 (ANC, skilled birth attendance, EmOC (including injectable antibiotics, injectable oxytocics, injectable anticonvulsants, manual removal of placenta, removal of retained products, assisted vaginal delivery, caesarean section and blood transfusion), PNC and family planning)[12] will be considered in this review. Full and partial economic evaluation studies have been selected as both typically report cost data,[30] which is the focus of this review. Articles published in the peer-review or grey literature after year 2000 will be included if these present primary data on cost of any of the maternal health services provided to women regardless of the level of care (primary, secondary or tertiary levels) and collected from one or multiple LMIC(s), as defined by the World Bank.[21] Studies published year 2000 onwards are deemed most relevant for the post-2015 era of the SDGs.

Exclusion criteria

Commentaries, editorials, letters that only broadly discuss the cost of providing maternal health services, as well as other reviews, will be excluded. In addition, articles will be excluded if the maternal health services are provided by individuals who are not legally allowed to provide such services in the country of study based on published national policy guidelines. In addition, health services that are part of the continuum of care but focused on newborn, children or adolescents [12] will be excluded.

Quality assessment of included studies

The 24-item Consolidated Health Economic Evaluation Reporting Standards (CHEERS) checklist has typically been used for assessing the quality of reporting of the full economic evaluations.[31] However, as many of the studies that will be included in this review may be purely cost analyses, which are a form of partial economic evaluations,[30] an adapted quality

assessment tool, which incorporates the relevant cost-focused criteria in the CHEERS checklist and those in the British Medical Journal Economic Evaluation Working Party,[32] will be used. This choice is based on insight from quality assessments that have been conducted in similar systematic reviews that focused on cost of services.[33,34]

Specifically for this review, quality criteria to be used for assessment will include completeness of the title and abstract (or executive summary in the case of grey literature reports), clarity on the broad context for the study and study question, description of characteristics of the population, costs perspective used and time horizon, description of methods used to estimate costs, report on dates of the estimated costs and unit costs as well as methods used in converting costs into a common currency base and the exchange rate. In addition, the review will assess presentation of key study findings including a detailed breakdown of costs incurred, description of how conclusions were reached, discussion of study limitations and the generalisability of the findings and how the findings fit with current knowledge.[31,35]

For each item, a score of 1 will be awarded if the criterion is fully met, 0.5, if partially met, 0, if not met or if only minimal information was provided, and NA if not applicable. The total score achieved across all the criteria will be subsequently summed-up and converted to percentages. As has been done in other similar reviews,[33,36] studies with 75% or more criteria fully met will be classified as high quality, 50-74% as average quality and below 50% as poor quality. Each included study will be assessed independently by two co-authors (ABT and MA).

Data extraction

We will use two pre-developed Microsoft Excel© (Microsoft Corporation, Redmond, U.S.) forms focused on quality assessment and evidence synthesis to extract data for this review. For all included articles, we will collect data on the article description (authors, year of publication, article title, journal), study setting (country of study, country of organisation conducting study, characteristics of women receiving maternal health services who were surveyed or for whom costs data were collected, perspective of costing (health system, government or societal), study design (cost analysis, partial economic evaluation, full economic evaluation or nested in another study), costing of maternal health services (intervention(s) costed, costing method used (top-down or expenditure approach that involves breaking down total cost into component costs (C_{Total}=>C_1+C_2+C_3) vs. bottom-up or ingredient approach that involves building-up the component/ingredient cost to estimate the total cost (C_1 +C_2+C_3 =>C_{Total})), time frame, facility type (health centre, hospital), facility ownership (private, public or mission), number of facilities, component of cost included (for example, start-up cost, running cost, cost of labour, equipment, medicines, supplies and for those who do, opportunity cost[30] etc.), year of costs data, currency and discount rate) as well as findings reported (including total service cost estimates per time period or where reported, cost per client visit). For articles which take a societal perspective and report the cost of utilising services, we will collect non-health facility-related costs such as transport. Guidance on costs data to be collected were sought from a previous review[20] and an expert opinion.[35]

Data extraction will be conducted independently by two of the co-authors (ABT and IOA) independently and then checked for accuracy by a third reviewer (OBT). To minimize

inconsistency between reviewers, we will conduct training and calibration exercises using the data extraction form prior to the commencement of the systematic review. In cases where data is missing from articles and not publicly available, we will make attempts to contact the study authors directly via the contact information provided in the study or report, or by using portals such as ResearchGate and LinkedIn.

Data synthesis

Characteristics of included studies will be summarised, and cost data provided by the authors will be collated within Microsoft Excel© (Microsoft Corporation, Redmond, U.S.). Using a sub-group analysis, the different costs items associated with each service (medicines and supplies, equipment, and labour costs) will be identified. Articles that include lump costs that cannot be disaggregated into service categories within the continuum of care pathway (i.e. ANC, skilled birth attendance, EmOC, PNC and family planning)[12] will be analysed separately. Opportunity costs will be excluded before totalling the direct financial cost of each service, as not all costing studies typically include it.[33] Comparison of service costs across countries will be performed. To allow ease of cost comparisons, purchasing power parity (PPP) conversion factors[37] will be used to convert the local currency of the country in which the study was conducted to International Dollar (I$) equivalents for the reported year of cost data collection.[38] Costs reported in US dollars using 'market exchange rates' will first be converted to local currency for the year the costing was done, using official OANDA exchange rates before being converted to I$ using PPP factors.[39] PPP, as opposed to market exchange rates, allows hypothetical estimation of the amount it would cost to purchase the same market basket of goods in various countries if their currencies were at par.[38] Based on these newly calculated I$ equivalents, the unit cost per service will be calculated.

In addition, we will conduct a sensitivity analysis by repeating our analysis to include studies that only partly failed to meet our inclusion criteria.[40] Risk of bias analysis will not be performed for this systematic review as it is focused only on costs and not effectiveness metrics, which would be required for such analysis.[41]

Finally, we will compare costs from each country and try to explain the reasons for any observed similarities and differences. Where we find that it will not be possible to pool some findings together due to methodological heterogeneity, we will conduct a narrative synthesis of the available information. In doing this, relevant country-specific issues related to delivering and utilising maternal health services in the individual study countries will be highlighted and used to explain findings. In addition, in line with global guidance for conducting economic evaluations,[42] by implementing targeted searches of the literature (peer-reviewed and grey literature), we will attempt to identify the population contextual and intervention design characteristics that help support lower costs (cost-savings) and improve the efficiency of maternal health service provision in LMICs. Furthermore, where possible, we will highlight the major cost drivers in providing maternal health services, as identified by the authors of the studies included in our review and/or based on our analysis which will show the largest component cost attributable to each service. These findings will constitute critical lessons that could be transferred from one LMIC to another.

Ethics and dissemination

No ethical approval will be required, as this review is based on already published data and does not involve interaction with human subjects. The plan for dissemination, however, is to

publish the findings of the review in a peer-reviewed journal and present findings at high-level international conferences that engage the most pertinent stakeholders. The proposed systematic review will provide a detailed summary of available evidence on costs maternal health services across the continuum of care and will complement evidence from modelled costing analysis conducted to estimate projected costs of achieving the SDG targets in LMICs.[43]

DISCUSSION

This protocol has been rigorously developed and designed specifically to assess the cost of maternal health services in LMICs. Given the limited recent evidence of cost associated with providing these critical services, findings from the review will be critical for researchers, policy-makers, government and non-governmental organisations for planning maternal and newborn health services in LMICs. If protocol modifications are required, the authors will include the detailed description of any changes along with a justification during the publication of the review.

Clearly, in the era of the SDGs in which the focus is to ensure that "no one is left behind" including in terms of receiving critical health care,[3] require up-to-date information on the costs associated with these services. This systematic review will be a one-stop shop for such data.

Footnotes

Contributors: ABT conceived the review. ABT, OBT and CA designed the review. IOA refined the review design. ABT and AM were involved in the initial drafting of the manuscript. All

authors were involved in subsequent draft manuscript reviews and updates and approved the final version of this protocol.

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Competing interests: None declared.

Patient consent: Not required.

Provenance and peer review: Not commissioned; externally peer reviewed.

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Tables

Table 1: Definition of key terms relevant to the systematic review

Key terms	Definitions
Antenatal care (ANC)	care provided by skilled health care professionals to pregnant women in order to ensure the best health conditions for both mother and baby during pregnancy.
Skilled birth attendance	delivery by a health professional who can identify and manage normal labor and delivery; and identify and treat complications or provide basic care and referral conducted within an enabling environment.
Emergency obstetric care (EmOC)	care package required to treat complications that arise from pregnancy and childbirth. There are two levels of care (basic and comprehensive). Basic EmOC includes parenteral administration of parenteral antibiotics, uterotonic drugs and parenteral anticonvulsants, manual removal of placenta, removal of retained products, and performance of assisted vaginal delivery. At a higher level of care, comprehensive EmOC includes all Basic EmOC interventions, blood transfusion and caesarean section services.
Postnatal care	care given to the mother immediately after the birth and for the first six weeks of life.
Family planning services	Services including educational, comprehensive medical or social activities which enable individuals, including minors, to determine freely the number and spacing of their children and to select the means by which this may be achieved (For this review, focus will be on women).

Table 2: Search terms to be adapted for use in the different databases for the review

Search term category	Specific search term
Intervention	"ante*natal care" OR ANC OR "birth" OR "skilled birth attendance" OR "obstetric emergenc*" OR "emergency obstetric care" OR EmOC OR OR "caesarean*" OR "vacuum" OR "post*natal care" OR "PNC" OR obstetric OR delivery OR maternity OR "family planning" OR contraception
Cost	"cost*" OR "cost of care" OR "cost*analysis" OR "cost*effectiveness" OR "cost*utility" OR "cost*benefit" OR "economic evaluation"
Setting of interest	"Low-and-Middle-Income Countr*", "low income countr*", "Africa", "sub-Saharan Africa", "Asia", Afghanistan, Angola, Bangladesh, Benin, Bhutan, Bolivia, Botswana, "Burkina Faso", Burundi, "Cabo Verde", Cambodia, Cameroon, "Central African Republic", Chad, Comoros, "Democratic Republic of Congo", Congo, "Côte d'Ivoire", Cuba, Djibouti, Egypt, "El Salvador", "Equatorial Guinea", Eritrea, Ethiopia, Fiji, Gabon, Gambia, Georgia, Ghana, Guinea, Guinea-Bissau, Guyana, Haiti, Honduras, India, Indonesia, Iran, Iraq, Jamaica, Kazakhstan, Kenya, Kiribati, "Democratic People's Republic of Korea", Kosovo, Kyrgyzstan, "Lao People's Democratic Republic", Lebanon, Lesotho, Liberia, Libya, Madagascar, Malawi, Maldives, Mali, Mauritania, Micronesia, Moldova, Mongolia, Morocco, Mozambique, Myanmar, Namibia, Nauru, Nepal, Nicaragua, Niger, Nigeria, Pakistan, Palau, Panama, "Papua New Guinea", Paraguay, Peru, Philippines, Rwanda, "São Tomé and Príncipe", Senegal, Serbia, "Sierra Leone", "Solomon Islands", Somalia, "South Africa", "South Sudan", "Sri Lanka", Sudan, Swaziland, "Syrian Arab Republic", Tajikistan, Tanzania, Thailand, Timor-Leste, Togo, Tokelau, Tonga, Tunisia, Uganda, Ukraine, Uzbekistan, Vanuatu, Venezuela, Vietnam, "Wallis and Futuna", "West Bank and Gaza Strip", Yemen, Zambia, Zimbabwe

Figure titles

Figure 1: Summary of search strategy search process

Online supplementary materials

File name: Online supplementary material S1
File format: pdf
Title of data: Completed PRISMA-P checklist
Description of data: Completed Preferred Reporting Items for Systematic Reviews and Meta-Analyses for Protocols 2015 checklist

File name: Online supplementary material S2
File format: pdf
Title of data: Full search strategy implemented in Scopus
Description of data: Full search strategy implemented in Scopus

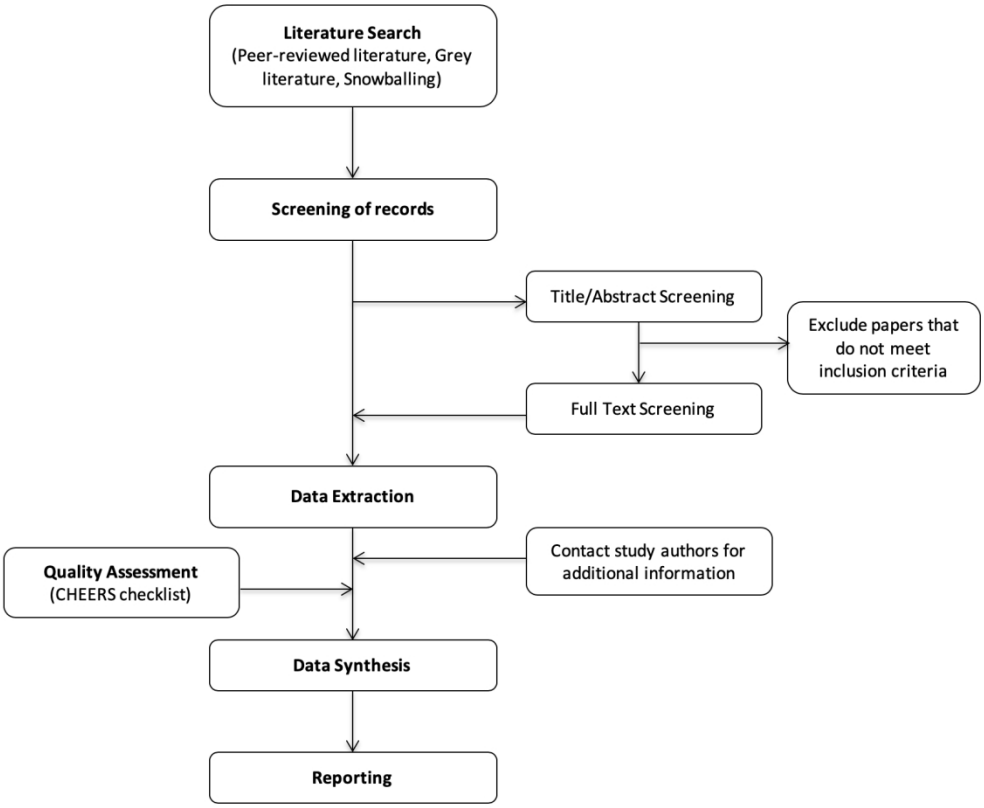

Figure 1: Summary of search strategy search process

PRISMA-P checklist: *Cost of Maternal Health Services in Low- and Middle-Income Countries: Protocol for a Systematic Review – Banke-Thomas et al. 2018*

Checklist #	Checklist item	Achieved	Verification
1a	Identify the report as a protocol of a systematic review.	Yes	Stated in the title
1b	If the protocol is for an update of a previous systematic review, identify as such.	N/A	
2	If registered, provide the name of the registry (e.g., PROSPERO) and registration number.	Yes	PROSPERO Reg. #: CRD42018114124
3a	Provide name, institutional affiliation, and e-mail address of all protocol authors; provide physical mailing address of corresponding author.	Yes	Achieved in Title page.
3b	Describe contributions of protocol authors and identify the guarantor of the review.	Yes	Article footnote.
4	If the protocol represents an amendment of a previously completed or published protocol, identify as such and list changes; otherwise, state plan for documenting important protocol amendments.	N/A	
5a	Indicate sources of financial or other support for the review.	N/A	
5b	Provide name for the review funder and/or sponsor.	N/A	
5c	Provide name for the review funder and/or sponsor.	N/A	
6	Describe the rationale for the review in the context of what is already known.	Yes	Introduction
7	Provide an explicit statement of the question(s) the review will address with reference to participants, interventions, comparators, and outcomes (PICO).	Yes	Introduction
8	Specify the study characteristics (e.g., PICO, study design, setting, time frame) and report characteristics (e.g., years considered, language, publication status) to be used as criteria for eligibility for the review.	Yes	Methods and analysis
9	Describe all intended information sources (e.g., electronic databases, contact with study authors, trial registers, or other grey literature sources) with planned dates of coverage.	Yes	Methods and analysis
10	Present draft of search strategy to be used for at least one electronic database, including planned limits, such that it could be repeated.	Yes	Table 1
11a	Describe the mechanism(s) that will be used to manage records and data throughout the review.	Yes	Methods and analysis
11b	State the process that will be used for selecting studies (e.g., two independent reviewers) through each phase of the review (i.e., screening, eligibility, and inclusion in meta-analysis.	Yes	Methods and analysis
11c	Describe planned method of extracting data from reports (e.g., piloting forms, done independently, in duplicate), any processes for obtaining and confirming data from investigators.	Yes	Methods and analysis
12	List and define all variables for which data will be sought (e.g., PICO items, funding sources), any pre-planned data assumptions and simplifications.	Yes	Methods and analysis
13	List and define all outcomes for which data will be sought, including prioritization of main and additional outcomes, with rationale.	N/A	
14	Describe anticipated methods for assessing risk of bias of individual studies, including whether this will be done at the outcome or study level, or both; state how this information will be used in data synthesis.	N/A	
15a	Describe criteria under which study data will be quantitatively synthesized.	Yes	Methods and analysis
15b	If data are appropriate for quantitative synthesis, describe planned summary measures, methods of handling data, and methods of combining data from studies, including any planned exploration of consistency.	Yes	Methods and analysis
15c	Describe any proposed additional analyses (e.g., sensitivity or subgroup analyses, meta-regression).	Yes	Methods and analysis
15d	If quantitative synthesis is not appropriate, describe the type of summary planned.	Yes	Methods and analysis
16	Specify any planned assessment of meta-bias(es) (e.g., publication bias across studies, selective reporting within studies).	Yes	Methods and analysis
17	Describe how the strength of the body of evidence will be assessed (e.g., GRADE).	Yes	Methods and analysis

Online supplementary material S2: Full search strategy implemented in Scopus

Search conducted	Specific search term and number of records retrieved
Services (Year 2000 onwards)	(TITLE-ABS-KEY ("ante*natal care" OR anc OR "birth" OR "skilled birth attendance" OR "obstetric emergenc*" OR "emergency obstetric care" OR "emergency obstetric and newborn care" OR emoc OR emonc) AND PUBYEAR > 1999) OR (TITLE-ABS-KEY ("caesarean*" OR "vacuum" OR "post*natal care" OR "PNC" OR obstetric OR newborn OR delivery OR maternity OR "family planning" OR contraception) AND PUBYEAR > 1999) 1,585,263 records
Cost (Year 2000 onwards)	TITLE-ABS-KEY (cost* OR "cost of care" OR "cost*analysis" OR "cost*effectiveness" OR "cost*utility" OR "cost*benefit" OR "economic evaluation") AND PUBYEAR > 1999 2,029,490 records
Service AND cost (Year 2000 onwards)	((TITLE-ABS-KEY ("ante*natal care" OR anc OR "birth" OR "skilled birth attendance" OR "obstetric emergenc*" OR "emergency obstetric care" OR "emergency obstetric and newborn care" OR emoc OR emonc) AND PUBYEAR > 1999) OR (TITLE-ABS-KEY ("caesarean*" OR "vacuum" OR "post*natal care" OR "PNC" OR obstetric OR newborn OR delivery OR maternity OR "family planning" OR contraception) AND PUBYEAR > 1999)) AND (TITLE-ABS-KEY (cost* OR "cost of care" OR "cost*analysis" OR "cost*effectiveness" OR "cost*utility" OR "cost*benefit" OR "economic evaluation") AND PUBYEAR > 1999) 112,253 records
Service AND cost (Year 2000 onwards, limited by language)	((TITLE-ABS-KEY ("ante*natal care" OR anc OR "birth" OR "skilled birth attendance" OR "obstetric emergenc*" OR "emergency obstetric care" OR "emergency obstetric and newborn care" OR emoc OR emonc) AND PUBYEAR > 1999) OR (TITLE-ABS-KEY ("caesarean*" OR "vacuum" OR "post*natal care" OR "PNC" OR obstetric OR newborn OR delivery OR maternity OR "family planning" OR contraception) AND PUBYEAR > 1999)) AND (TITLE-ABS-KEY (cost* OR "cost of care" OR "cost*analysis" OR "cost*effectiveness" OR "cost*utility" OR "cost*benefit" OR "economic evaluation") AND PUBYEAR > 1999) AND (LIMIT-TO (LANGUAGE , "English") OR LIMIT-TO (LANGUAGE , "French")) 107,929 records
Service AND cost (Year 2000 onwards, limited by language and country of interest)	((TITLE-ABS-KEY ("ante*natal care" OR anc OR "birth" OR "skilled birth attendance" OR "obstetric emergenc*" OR "emergency obstetric care" OR "emergency obstetric and newborn care" OR emoc OR emonc) AND PUBYEAR > 1999) OR (TITLE-ABS-KEY ("caesarean*" OR "vacuum" OR "post*natal care" OR "PNC" OR obstetric OR newborn OR delivery OR maternity OR "family planning" OR contraception) AND PUBYEAR > 1999)) AND (TITLE-ABS-KEY (cost* OR "cost of care" OR "cost*analysis" OR "cost*effectiveness" OR "cost*utility" OR "cost*benefit" OR "economic evaluation") AND PUBYEAR > 1999) AND (LIMIT-TO (LANGUAGE , "English") OR LIMIT-TO (LANGUAGE , "French")) AND (LIMIT-TO (AFFILCOUNTRY , "India") OR LIMIT-TO (AFFILCOUNTRY , "Iran") OR LIMIT-TO (AFFILCOUNTRY , "Pakistan") OR LIMIT-TO (AFFILCOUNTRY , "Nigeria") OR LIMIT-TO (AFFILCOUNTRY , "Thailand") OR LIMIT-TO (AFFILCOUNTRY , "Kenya") OR LIMIT-TO (AFFILCOUNTRY , "Egypt") OR LIMIT-TO (AFFILCOUNTRY , "Uganda") OR LIMIT-TO (AFFILCOUNTRY , "Bangladesh") OR LIMIT-TO (AFFILCOUNTRY , "Indonesia") OR LIMIT-TO (AFFILCOUNTRY , "Ghana") OR LIMIT-TO (AFFILCOUNTRY , "Tanzania") OR LIMIT-TO (AFFILCOUNTRY , "Ethiopia") OR LIMIT-TO (AFFILCOUNTRY , "Viet Nam") OR LIMIT-TO (AFFILCOUNTRY , "Malawi") OR LIMIT-TO (AFFILCOUNTRY , "Philippines") OR LIMIT-TO (AFFILCOUNTRY , "Nepal") OR LIMIT-TO (AFFILCOUNTRY , "Zambia") OR LIMIT-TO (AFFILCOUNTRY , "Tunisia") OR LIMIT-TO (AFFILCOUNTRY , "Lebanon") OR LIMIT-TO (AFFILCOUNTRY , "Peru") OR LIMIT-TO (AFFILCOUNTRY , "Burkina Faso") OR LIMIT-TO (AFFILCOUNTRY , "Sri Lanka") OR LIMIT-TO (AFFILCOUNTRY , "Morocco") OR LIMIT-TO (AFFILCOUNTRY , "Zimbabwe") OR LIMIT-TO (AFFILCOUNTRY , "Cameroon") OR LIMIT-TO (AFFILCOUNTRY , "Rwanda") OR LIMIT-TO (AFFILCOUNTRY , "Congo") OR LIMIT-TO (AFFILCOUNTRY , "Senegal") OR LIMIT-TO (AFFILCOUNTRY , "Mozambique") OR LIMIT-TO (AFFILCOUNTRY , "Botswana") OR LIMIT-TO (AFFILCOUNTRY , "Mali") OR LIMIT-TO (AFFILCOUNTRY , "Iraq") OR LIMIT-TO (AFFILCOUNTRY , "Cuba") OR LIMIT-TO (AFFILCOUNTRY , "Sudan") OR LIMIT-TO (AFFILCOUNTRY , "Benin") OR LIMIT-TO (AFFILCOUNTRY , "Gambia") OR LIMIT-TO (AFFILCOUNTRY , "Guatemala") OR LIMIT-TO (AFFILCOUNTRY , "Papua New Guinea") OR LIMIT-TO (AFFILCOUNTRY , "Cote d'Ivoire") OR LIMIT-TO (AFFILCOUNTRY , "Jamaica") OR LIMIT-TO (AFFILCOUNTRY , "Afghanistan") OR LIMIT-TO (AFFILCOUNTRY , "Kazakhstan") OR LIMIT-TO (AFFILCOUNTRY , "Madagascar") OR LIMIT-TO (AFFILCOUNTRY , "Panama") OR LIMIT-TO (AFFILCOUNTRY , "Laos") OR LIMIT-TO (AFFILCOUNTRY , "Myanmar") OR LIMIT-TO (AFFILCOUNTRY , "Fiji") OR LIMIT-TO (AFFILCOUNTRY , "Haiti") OR LIMIT-TO (AFFILCOUNTRY , "Moldova") OR LIMIT-TO (AFFILCOUNTRY , "Bolivia") OR LIMIT-TO (AFFILCOUNTRY , "Honduras") OR LIMIT-TO (AFFILCOUNTRY , "Niger") OR LIMIT-TO (AFFILCOUNTRY , "Namibia") OR LIMIT-TO (AFFILCOUNTRY , "El Salvador") OR LIMIT-TO (AFFILCOUNTRY , "Gabon") OR LIMIT-TO (AFFILCOUNTRY , "Sierra Leone") OR LIMIT-TO (AFFILCOUNTRY , "Syrian Arab Republic") OR LIMIT-TO (AFFILCOUNTRY , "Yemen") OR LIMIT-TO (AFFILCOUNTRY , "Uzbekistan") OR LIMIT-TO (AFFILCOUNTRY , "Democratic Republic Congo") OR LIMIT-TO (AFFILCOUNTRY , "Libyan Arab Jamahiriya") OR LIMIT-TO (AFFILCOUNTRY , "Togo") OR LIMIT-TO (AFFILCOUNTRY , "Burundi") OR LIMIT-TO (AFFILCOUNTRY , "Swaziland") OR LIMIT-TO (AFFILCOUNTRY , "Angola") OR LIMIT-TO (AFFILCOUNTRY , "Eritrea") OR LIMIT-TO (AFFILCOUNTRY , "Guinea") OR LIMIT-TO (AFFILCOUNTRY , "Lesotho") OR LIMIT-TO (AFFILCOUNTRY , "Chad")) OR LIMIT-TO (AFFILCOUNTRY , "Undefined")) 12,529 records