

# Review of health and non-health sector indicators for monitoring service provision along the continuum of care for maternal health

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## Research note

**Keywords:** continuum of care for maternal health; health service indicators; social determinants of health indicators; adequacy construct for the continuum of care for maternal health.

**Posted Date:** February 26th, 2020

**DOI:** <https://doi.org/10.21203/rs.2.22005/v3>

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**Version of Record:** A version of this preprint was published at BMC Research Notes on March 13th, 2020. See the published version at <https://doi.org/10.1186/s13104-020-04984-9>.

# Abstract

**Objective :** This study uses health and non-health sector data sources to select and assess available indicators for service provision along the continuum of care for maternal health at subnational levels in South Africa. It applies the adequacy approach established in another study to assess the multi-dimensionality of available indicators. Using adequacy and the process of assessment in the study, the comprehensiveness of the continuum of care for improving maternal health outcomes can be assessed. **Results:** We found 27 indicators of care utilization and access, linkages of care, and quality of care from the routine district health information system. The General Household Survey contained 11 indicators for the social determinants of health on the continuum of care framework. Indicator gaps include health promotion during and after pregnancy, maternal nutrition, empowerment and quality of care. At present, the available indicators measure about 74% of the interventions on the continuum of care framework. We make recommendations regarding improvements needed to better measure and monitor the continuum of care for maternal health. These involve actions within the health system and include integration of non-health system indicators.

## Introduction

The continuum of care is a strategy for improving the efficiency and effectiveness of service delivery for maternal health[1], [2]. It is the delivery of services from preconception to the postnatal period, including those related to social determinants of health. The continuum of care (CoC) framework, developed by national stakeholders in South Africa, is presented in Figure 1. It outlines linked intervention packages from the family/community to the district level of care. South Africa (SA) has a strategic goal to deliver and monitor services along the CoC in maternal and related health areas [3], [4]. However, there is a gap in defining the indicator set for monitoring service delivery (mainly inputs, outputs and processes) along the CoC to support these goals.

In a previous study, we described the construct of adequacy, which emerged from a systematic review and critical interpretive synthesis of gaps in measurement of the CoC[5]. The adequacy approach states that the CoC should be measured and monitored in a comprehensive and multidimensional manner. This means all aspects of timely access to care, quality of care, linkages between levels of care, and social determinants of health should be measured. The framework in Figure 1 guides the essential interventions and highlights their linkages, while the adequacy approach integrates multidimensional quality of care measurement. . In this study we used the framework in Figure 1 and the adequacy construct to i) propose an indicator tool for the CoC for maternal health in SA , and ii) describe current gaps to be addressed in improving monitoring and provision of services.

## Methods

In this study we assess available indicators currently used for health and non-health sector policy and planning in government programs. They thus have a defined monitoring purpose which is re-assessed for

suitability to the CoC framework.

### *Indicator extraction*

We used the routine district health information system (DHIS) to extract relevant health system indicators. The DHIS monitors health programmes, track patients and map service availability in the health system in SA[6]. The National Indicator Data Set (NIDS) within the DHIS contains indicators of service inputs, processes, outputs and outcomes (where relevant) extracted for this study, for the reference period April 2017 - March 2019 [7]. For social determinants of health/ intersectoral factors as outlined in Figure 1, we assessed datasets on the Statistics SA Nesstar portal and selected the General Household Survey (GHS) (reference year 2017) as the most suitable source. The GHS is annually collected and contains data on all intersectoral factors, which are used in policy and planning in SA[8], [9]. All GHS data can be obtained from the DataFirst Portal of the University of Cape Town in SA[10].

### *Indicator evaluation*

The health service indicators from the DHIS were evaluated for suitability to the framework based on their current monitoring purposes and recommendations from existing guidelines. These guidelines included:

- Annual performance plans of the Department of Health in SA
- Guidelines for maternity care in South Africa
- The strategic objectives of the global network to improve Quality, Equity and Dignity in maternal, newborn and child health [11].
- Resources exploring the WHO Quality of Care Framework for maternal and new-born health [12], [13].
- Global Review of Key Interventions related to reproductive, maternal, newborn and child health [14].
- Guidelines for positive birth experience with a focus on monitoring Intrapartum care [15].
- Quality of care at primary (Ideal Clinic Realization and Maintenance Program) and hospital (National Core Standards) level in SA[16], [17]

For social determinants of health, we relied on literature focusing on the relationship between interventions and maternal health outcomes. We also relied on recommendations by the WHO and Commission on Social Determinants of Health[18], conceptual framework of the social determinants of health[19], and frameworks for practice at country level[20]. The evaluation of indicators also revealed outstanding gaps in measuring interventions on the framework, which we describe in this study.

## **Results**

### *Indicator set*

In Figure 2 we present a set of 38 indicators that were extracted and evaluated from the DHIS and GHS (27 indicators from the health system and 11 for the intersectoral factors). The figure also describes measurement gaps per intervention package of the CoC. As Figure 2 shows, indicators are available for

most of the intervention packages on the CoC framework. The exceptions were danger sign recognition and emergency preparedness, healthy behaviour promotion and indicators for emergency pregnancy care. The lack of indicators demonstrates unavailable services and/or poor monitoring by the health system. Sometimes indicators are available that do not directly measure maternal health outcomes. Figure 2 shows proxies such as food fortification compliance rates (Indicator 3) used by the health system at community level. Other proxies include Ideal Clinic status (Indicator 20) and national core standards (Indicator 21), which are summary measures of quality of care at facility level. Where only proxies are available, we recommend health information system improvements to measure and integrate measures that are more directly related to maternal health outcomes.

Even where indicators are available, measurement improvements can be made in order to monitor each intervention package comprehensively. Each intervention package consists of more than one intervention, as shown in Figure 1. For example, while Reproductive Care at district hospital may include timely termination of pregnancy indicators, there is a gap in monitoring post-abortion care and treatment of complicated STIs as part of the package. Thus, more research is needed to assess the extent to which the health system provides services within each intervention package of the CoC. New health system interventions, such as Human Papillomavirus (HPV) vaccinations for school going girls and health promotion through mobile phones (MomConnect program), should be monitored through the DHIS. This will improve the comprehensiveness of the data set and ease of monitoring the CoC in the health system.

Quality of care was an under-measured aspect of interventions such as antenatal care visits, normal and Caesarean deliveries, and postnatal visits. There is a need for intervention specific qualities of care indicators, as exemplified by retest rates for HIV positive clients during antenatal care (Indicator 11, Figure 2). The health system runs parallel quality of care systems for maternal health, particularly the confidential maternal mortality audits[21]. We recommend the establishment of routine measures from these sources for integration into the DHIS. Routine quality of care monitoring should also include reporting of safety incidents and experience of care surveys disaggregated by population groups.

While indicators are available for the intersectoral factors in the framework, we observed gaps in monitoring indoor air pollution, maternal nutrition counselling, and women's empowerment for decision making and demand for healthcare. Like health system interventions, each intersectoral factor could be measured by more than one indicator. For instance, in the water and sanitation intervention package, the GHS had variables that could assess safety of water, infrastructure and basic sanitation (Indicators 28-30). While educational achievement indicators may be straightforward, factors such as empowerment and nutrition are more multifaceted. Thus, a variety of indicators can be isolated for their measurement, depending on data availability.

In summary, Figure 2 is the indicator tool which provides a description of available indicators and gaps that need to be addressed to monitor the CoC for maternal health. The gaps identified should not preclude use of the tool to assess the nature and extent of provision of services along the CoC for

maternal health in future studies. The improvement and validation of indicators in maternal health should be a continuous process, tied to evolving policies and information system improvements[22].

### *Adequacy assessment*

In Figure 3 indicators are grouped according to adequacy dimensions, and the information in Figure 2 used to subjectively assess the level to which intervention packages can be measured by available indicators. We assign “partial” (orange) measurement if indicators are available but there are measurement gaps identified. When assigned “no” (red) if no indicators or proxies were identified from the data sources. And we assigned “yes” (green) if, according to literature and existing guidelines, there are indicators available to measure the intervention package. Availability of indicators for an intervention package does not preclude future rigorous validation processes and iterations; this is a normal process within the health information system that is encouraged.

All dimensions of the CoC can be measured by current indicators, although gaps remain within specific intervention packages. Data gaps were most prevalent in the care access and utilization dimension, where 40% (6/15) of intervention packages had no indicators available. Dimensions of quality and linkages of care can only be partially measured; while only 40% (2/5) of social determinants of health domains have available indicators. In general, the GHS and the DHIS provide indicator data for measurement and monitoring of the majority (74%) of CoC intervention packages (17/23) as defined by the framework in Figure 1.

## **Discussion**

This study developed and assessed the indicator tool for the continuum of care framework for maternal health in South Africa. This process can be applied to newborn and child health indicators within the framework, using relevant data sources. These processes contribute to the operationalization of the framework, in order to fulfil health system goals in comprehensive monitoring and evaluation of maternal health[23]. Our study also advances the application of the adequacy approach to assess the multi-dimensionality of the available indicators. The adequacy approach complements the framework developed by health system actors by integrating quality of care measures. The CoC has been criticized for under-emphasizing quality of care[24]. For instance, there is still a gap in monitoring quality of care signal functions for maternal health through the DHIS. Data from many programs in the health system are collected separately and only later incorporated into the DHIS[25]. We recommend future research for assessing feasibility of integration of quality of care and service programs data into the routine monitoring and evaluation systems.

Interventions that signify “linkages of care” were also not well defined prior to our study. For that purpose, we proposed the use of indicators for patient transport from community to facility and in-between facilities. Transport facilitates referrals between different levels of care, and an important determinant of maternal mortality in SA [26]. Referrals encompass not only transport but also matching skills to patient needs and managing congestion in facilities[26]. Thus, more research is needed to

identify indicators for monitoring human resources and patient management factors in facilities that can contribute to the framework. Our study identified a gap in linkages between one intervention package and another, which is also an important determinant of maternal health outcomes[27], [28]. The CoC framework improves on the country's strategic plan because it includes more social determinants than water and sanitation[23]. Other frameworks propose even more social determinants, such as occupation, social class, race and ethnicity, social environment and psychosocial circumstances, and behavioural factors[19]. In this study we focused on the domains specified by the framework and recommend future research to explore feasibility of additional indicators.

In conclusion, this study proposed a multidimensional, comprehensive indicator set that can be used to assess the continuum of maternal health care in public health research and practice. The indicator set integrates the under-specified aspects of the framework, such as quality of care and broader social determinants of health, thus improving its potential use from a multisectoral perspective.

### **Limitations**

The indicators used are only applicable to the South African context, but the adequacy model can be used by researchers from other LMICs to guide a multidimensional analysis of information in their context. We identified and assessed indicators only for the intervention packages outlined in the CoC framework and the dimensions proposed through the adequacy model. We recommend on-going research to refine the framework and indicators suitable for maternal health CoC.

## **List Of Abbreviations**

CoC - Continuum of Care

DHIS – District Health Information Systems

GHS – General Household Survey

HPV – Human Papillomavirus

LMIC – Low- and Middle-Income Countries

NIDS – National Indicator Data Set

SA – South Africa

STIs – Sexually Transmitted Illnesses

WHO – World Health Organization

## **Declarations**

Ethics approval and consent to participate

Not applicable

Consent for publication

Not applicable

Availability of data and materials

The datasets generated and/or analysed for the General Household Survey during the current study are available in the DataFirst repository, [<https://www.datafirst.uct.ac.za/dataportal/index.php/catalog/central>][10]. The datasets generated and/or analysed for the District Health Information System during the current study are available in the National Department of Health Data Dictionary repository, [<https://dd.dhmis.org/>][7].

Competing interests

The authors declare that they have no competing interests

Funding

This work is based on the research supported by the South African Research Chairs Initiative of the Department of Science and Technology and National Research Foundation of South Africa (grant no 82769). The authors would also like to acknowledge funding from the South African Medical Research Council and the Belgian Development Cooperation, through the Institute of Tropical Medicine Antwerp. Any opinion, finding and conclusion or recommendation expressed in this material is that of the authors and not the funders. The funders did not have a role in the design of the study and collection, analysis, and interpretation of data and in writing the manuscript.

Authors' contributions

MM and LM conceptualized the study. MM conducted data collection and analysis. LM and HM guided additional analysis of data. MM, LM, HT were involved in writing and revision of manuscript. All authors read and approved the final manuscript.

Acknowledgements

Not applicable

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## Figures

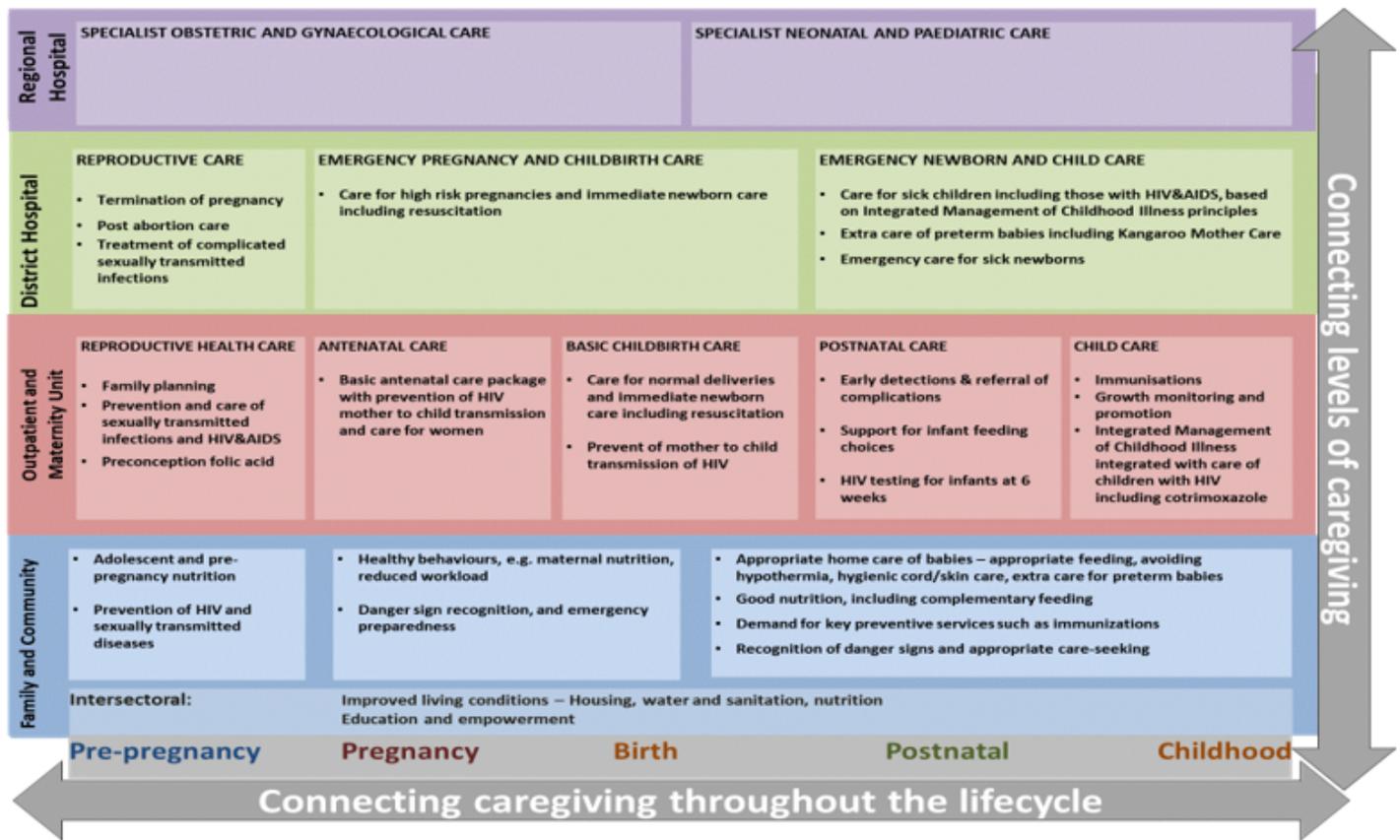


Figure 1

Continuum of care framework for maternal and child health in South Africa. The continuum of care framework for South Africa was developed by national health system stakeholders and decision makers [2]. It outlines important evidence based interventions to improve maternal and child health outcomes across the continuum of care. Our study focuses on maternal health aspects. Interventions are implemented across the lifecycle from pre-pregnancy to postnatal period. The levels of care are outlined vertically, and the framework recommends connectedness or linkages between these levels to improve care. In addition, connection between intervention packages (boxed and colour coded) are important. As a primary health care framework, delivery of services on the continuum of care occurs at the district level and below. Besides health system interventions are “intersectoral factors” that represent important social determinants of health for maternal health. These include good living conditions, empowerment and education.

Level of care	Intervention	Indicators	Units	Responsibility	Gaps
1-2 Pre-pregnancy Community	Reproductive Health	Female and male condom distribution coverage	DMIS	Condoms distributed from a primary distribution site to health facilities or points in the community (e.g. campaigns, one-to-one outlets, etc.)	There is need to monitor screening and vaccination for Human Papilloma Virus (HPV) as per core policy of vaccination in school-going girls... This indicator reflects community level exposure. More indicators can be explored that are directly related to adolescent and pre-conception nutrition, such as provision of micronutrient supplementation.
3	Adolescent Preconception nutrition	MHA, malnutrition compliance rate	DMIS	Operational done and mass eating establishments that were compliant with Fortification Regulations under the FCTD. And as a proportion of eating establishments that were inspected.	
4 Pre-pregnancy Primary health facility	Reproductive Health	Contraceptive use	DMIS	Women protected against pregnancy by using modern contraceptive methods, including sterilizations, as proportion of female population 15-49 years.	Need to monitor post-partum family planning
5-7 Pre-pregnancy District hospital	Reproductive Care	Termination of pregnancy <12 weeks rate and 13-20 weeks rate and under 20 years rate	DMIS	Pregnancies terminated in health facilities as at specified gestation periods, or age of women, as a proportion of total termination of pregnancies.	Need to monitor post-abortion care and treatment of complicated STIs.
8 Pregnancy Community	Healthy behaviours				Outreach to households through ward based outreach teams could potentially include health promotion to encourage healthy behaviours. In addition, the MiniConnect platform which delivers cognitive messages for pregnant women can promote healthy behaviours. It is important to monitor the promotion of healthy behaviours through these interventions and additional care services.
9 Pregnancy Primary	Antenatal Care	Antenatal 1st visit	DMIS	Women who have a booking visit (first visit)	Indicators that monitor antenatal visits such as MiniConnect which were cellphone managed and primary health programmes need to be integrated into the DMIS as well as in public health facilities in the country increase functional of content during.
10	Health facility (with PMTCT)	before 20 weeks rate		before they are 20 weeks into their pregnancy as proportion of all antenatal 1st visits	antenatal care as included in clinical management modules of the Integrated Clinic quality improvement assessment tools.
11		Antenatal 1st visit coverage	DMIS	The proportion of potential antenatal clients coming for at least one (booked) antenatal visit. The census number of children under one year (numerator) by 1:1 is used as a proxy denominator. The extra 0.17 (17%) is a rough estimate to cover for late miscarriages (0-20 weeks), stillbirths (after 28 weeks gestation) and other mortality. Pregnant women are regarded as potential antenatal clients from around 10 weeks' gestation, i.e. spontaneous abortions before that as well as TOP cases are excluded.	Besides MCH, there is need to integrate remaining indicators for TB diagnosis and treatment.
12		Antenatal client HIV in last case remaining among pregnant HIV clients	DMIS	Antenatal clients re-tested for HIV as proportion of antenatal clients tested negative for 1st HIV tests done during current pregnancy	
13		Antenatal client start on ART rate	DMIS	Antenatal clients who started on ART as a proportion of the total number of antenatal clients who are HIV positive and not on ART	
14		Syphilis positive pregnant females received blood transfusion 1% of all pregnant 1st and 2nd dose rate	DMIS	Syphilis positive pregnant females who received blood transfusion 1% of all pregnant 1st and 2nd dose rate	
15		Emergency pregnancy care	DMIS	Deliveries in health facilities as proportion of expected deliveries in the population.	Need for indicators of high risk pregnancy care to be integrated into the DMIS
16	Primary health facility	Care for normal delivery and PMTCT	DMIS	Expected deliveries as estimated as population under 1 year multiplied by 0.23 to compensate for still births and infant mortality	Indicators for management of post-partum haemorrhage and other quality of care signal factors during childbirth.
17	Birth District hospital	Emergency childbirth care	DMIS	Delivery by Caesarean section as proportion of total deliveries in health facilities as proportion of	Need to monitor quality of care during Caesarean deliveries
18	Post-natal care Community	Recognition of danger signs and care-seeking rate			Outreach to households (OHH) with potential care indicators may include recognition of danger signs and care seeking. However, current indicators only measure visits and not the content of care. This intervention is also not provided to all women who deliver in public facilities.
19	Post-natal care Primary health facility	Early detection and referral of complications	DMIS	Mothers who received postnatal care within 8 days after delivery as proportion of deliveries in health facilities	Need to monitor the content of care in postnatal visits or obstetric referrals
20	Quality of care Primary health facility	Contraception	DMIS	Score out of 100 based on multidimensional measure of quality improvement with equal weight for maternal health, reflects national priorities of primary care level. The main dimensions include: 1. Administration 2. Integrated Clinical Services Management 3. Medication, Supplies and Laboratory Services 4. Human Resources for Health 5. Support Services 6. Substructure 7. Health Information Management 8. Communication 9. District Health System Support 10. Implementing Partners and Stakeholders. All main dimensions have sub-components and specific measures to be assessed.	May be supplemented with more detailed signal factors data e.g. from the Department's maternal death audits and observational data. Reporting specific maternal health safety incidents using newly developed tool for Patient Safety Incident Reporting and Learning to be reported with future Integrated Clinic related data.
21	Quality of care District Hospital	Cross-cutting	DMIS	Score out of 100 as a multidimensional measure of quality improvement, without equal weight for maternal health. A 'availability of positions for clinical management' of gynaecological-obstetric conditions assessed via the NCI 1. Patient Safety 2. Patient Safety, Clinical Governance and Clinical Care 3. Clinical Support Services of Public Health 3. Leadership and Governance 4. Operational Management 7. Facilities and Infrastructure.	May be supplemented with more detailed signal factors data e.g. from the Department's maternal death audits and observational data.
22	Linkages of care Community	Cross-cutting	DMIS	Emergency obstetric care facility transfers response times under 60 minutes as a	Linkages across packages of care can be explored through research and formalisation of
23	Emergency Community (Intersectoral Factors)	Water and sanitation	DMIS	Domestic bacteriological and chemical water samples taken from 30 service attendances at a point of use that conforms to the standards set out in SANS 241 for drinking water quality and safety as a proportion of water samples collected.	Similar sanitation indicators may be collected by the health system as part of the Environmental Health assessment.
24		Water and sanitation	GIS	Proportion of women 15-49 in households with basic sanitation facilities.	
25		Water and sanitation	GIS	Proportion of women 15-49 living in households with 'good' or 'very good' wall, roof, and floor conditions of the dwelling.	
26		Water and sanitation	GIS	Proportion of women 15-49 in households with basic sanitation facilities.	
27		Water and sanitation	GIS	Proportion of women 15-49 living in households with 'good' or 'very good' wall, roof, and floor conditions of the dwelling.	
28		Water and sanitation	GIS	Proportion of women 15-49 in households with basic sanitation facilities.	
29		Water and sanitation	GIS	Proportion of women 15-49 living in households with 'good' or 'very good' wall, roof, and floor conditions of the dwelling.	
30		Water and sanitation	GIS	Proportion of women 15-49 in households with basic sanitation facilities.	
31		Water and sanitation	GIS	Proportion of women 15-49 living in households with 'good' or 'very good' wall, roof, and floor conditions of the dwelling.	
32		Water and sanitation	GIS	Proportion of women 15-49 in households with basic sanitation facilities.	
33		Water and sanitation	GIS	Proportion of women 15-49 living in households with 'good' or 'very good' wall, roof, and floor conditions of the dwelling.	
34		Water and sanitation	GIS	Proportion of women 15-49 in households with basic sanitation facilities.	
35		Water and sanitation	GIS	Proportion of women 15-49 living in households with 'good' or 'very good' wall, roof, and floor conditions of the dwelling.	
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67		Water and sanitation	GIS	Proportion of women 15-49 living in households with 'good' or 'very good' wall, roof, and floor conditions of the dwelling.	
68		Water and sanitation	GIS	Proportion of women 15-49 in households with basic sanitation facilities.	
69		Water and sanitation	GIS	Proportion of women 15-49 living in households with 'good' or 'very good' wall, roof, and floor conditions of the dwelling.	
70		Water and sanitation	GIS	Proportion of women 15-49 in households with basic sanitation facilities.	
71		Water and sanitation	GIS	Proportion of women 15-49 living in households with 'good' or 'very good' wall, roof, and floor conditions of the dwelling.	
72		Water and sanitation	GIS	Proportion of women 15-49 in households with basic sanitation facilities.	
73		Water and sanitation	GIS	Proportion of women 15-49 living in households with 'good' or 'very good' wall, roof, and floor conditions of the dwelling.	
74		Water and sanitation	GIS	Proportion of women 15-49 in households with basic sanitation facilities.	
75		Water and sanitation	GIS	Proportion of women 15-49 living in households with 'good' or 'very good' wall, roof, and floor conditions of the dwelling.	
76		Water and sanitation	GIS	Proportion of women 15-49 in households with basic sanitation facilities.	
77		Water and sanitation	GIS	Proportion of women 15-49 living in households with 'good' or 'very good' wall, roof, and floor conditions of the dwelling.	
78		Water and sanitation	GIS	Proportion of women 15-49 in households with basic sanitation facilities.	
79		Water and sanitation	GIS	Proportion of women 15-49 living in households with 'good' or 'very good' wall, roof, and floor conditions of the dwelling.	
80		Water and sanitation	GIS	Proportion of women 15-49 in households with basic sanitation facilities.	
81		Water and sanitation	GIS	Proportion of women 15-49 living in households with 'good' or 'very good' wall, roof, and floor conditions of the dwelling.	
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86		Water and sanitation	GIS	Proportion of women 15-49 in households with basic sanitation facilities.	
87		Water and sanitation	GIS	Proportion of women 15-49 living in households with 'good' or 'very good' wall, roof, and floor conditions of the dwelling.	
88		Water and sanitation	GIS	Proportion of women 15-49 in households with basic sanitation facilities.	
89		Water and sanitation	GIS	Proportion of women 15-49 living in households with 'good' or 'very good' wall, roof, and floor conditions of the dwelling.	
90		Water and sanitation	GIS	Proportion of women 15-49 in households with basic sanitation facilities.	
91		Water and sanitation	GIS	Proportion of women 15-49 living in households with 'good' or 'very good' wall, roof, and floor conditions of the dwelling.	
92		Water and sanitation	GIS	Proportion of women 15-49 in households with basic sanitation facilities.	
93		Water and sanitation	GIS	Proportion of women 15-49 living in households with 'good' or 'very good' wall, roof, and floor conditions of the dwelling.	
94		Water and sanitation	GIS	Proportion of women 15-49 in households with basic sanitation facilities.	
95		Water and sanitation	GIS	Proportion of women 15-49 living in households with 'good' or 'very good' wall, roof, and floor conditions of the dwelling.	
96		Water and sanitation	GIS	Proportion of women 15-49 in households with basic sanitation facilities.	
97		Water and sanitation	GIS	Proportion of women 15-49 living in households with 'good' or 'very good' wall, roof, and floor conditions of the dwelling.	
98		Water and sanitation	GIS	Proportion of women 15-49 in households with basic sanitation facilities.	
99		Water and sanitation	GIS	Proportion of women 15-49 living in households with 'good' or 'very good' wall, roof, and floor conditions of the dwelling.	
100		Water and sanitation	GIS	Proportion of women 15-49 in households with basic sanitation facilities.	

Figure 2

Description of indicators and gaps in monitoring interventions along the continuum of care for maternal health in South Africa. The indicator tool was developed to summarize available indicators, their source, and the data gaps that were observed in the study of the continuum of care for maternal health in South Africa. The levels of care and intervention package columns are based on the continuum of care framework developed by health system actors, and presented in Figure 1 of this study, and indicators are

grouped together to make the figure more concise (e.g. indicators 5-7 represents three indicators within the reproductive care package). The detailed definition and numerator and denominators of each indicator can be found in the metadata of the relevant data sources as specified in the Figure. The description of indicators gives a general guidance of the measures involved. Data gaps are also summaries from literature, global and national guidelines as specified in the manuscript.

<i>Dimension</i>	<i>Level of care</i>	<i>Intervention package</i>	<i>Indicators/proxies available</i>
Timely access and utilization of care	Family and community/Pre-pregnancy	Adolescence and pre-pregnancy nutrition	Yes
		Prevention of HIV/STIs	Yes
	Family and community/Pregnancy	Healthy Behaviour	No
		Danger Sign Recognition and Emergency Preparedness	No
	Family and Community/Postnatal	Danger sign recognition and appropriate care seeking, nutrition	No
	Primary health facility/ Pre-pregnancy	Family planning	Yes
		Prevention of HIV/STIs	Yes
		Preconception folic acid	No
	Primary health facility/Pregnancy	Basic Antenatal Care with PMTCT	Yes
	Primary health facility/Childbirth	Care for normal deliveries	Yes
	Primary health facility/ Postnatal care	Early detection and referral of complications	Partial
	District Hospital / Pre-pregnancy	Termination of pregnancy	Yes
		Post-abortion care	No
Treatment of complicated STIs		No	
District Hospital /Emergency Pregnancy and Childbirth Care	Care for high risk pregnancies	Partial	
Quality of Care	District Hospital/Crosscutting	Quality of care at secondary level	Partial
	Primary health facility/cross-cutting	Quality of care at primary level	Partial
Linkages of care	All levels/cross-cutting	Linkages of care levels (referrals)	Partial
Intersectoral factors/social determinants of health	Family and community/cross-cutting	Housing	Partial
		Water and Sanitation	Yes
		Nutrition	Partial
		Empowerment	Partial
		Education	Yes

**Figure 3**

Assessment of availability of indicators over dimensions and domains of the continuum of care for maternal health in South Africa. The dimensions of the continuum of care are defined according to the adequacy construct developed in a previous study[5]. The level of care and intervention packages contain indicators found in Figure 2 and are based on the continuum of care framework in Figure 1. We assign “partial” (orange) measurement if indicators are available but there are measurement gaps identified. When assigned “no” (red) when no indicators or proxies were identified from the data sources. And we assigned “yes” (green) if, according to literature and existing guidelines, the indicators available to measure the intervention package are considered adequate.