

UNIVERSITY OF THE WESTERN CAPE
Faculty of Community and Health Sciences
DOCTORAL THESIS

Title: Development of an approach for measurement and monitoring of the continuum of care for maternal health in the South African health system

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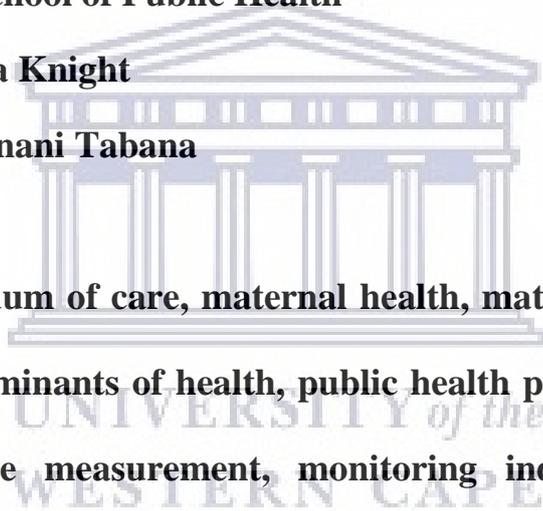
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Abstract

Background: The continuum of care is a public health framework for improving maternal health outcomes by providing comprehensive health services, at different levels of the health system and across the lifecycle. The framework emphasizes the importance of interventions to address the social determinants of health as well, alongside healthcare services. Although the framework is useful for visualizing service organization, it has not been adequately integrated into policy and practice in South Africa. In addition, there is currently no comprehensive approach to monitor and evaluate service provision along the continuum of care. The current approach is fragmented across programs and sectors and focuses on only a handful of indicators. This research explores an approach for measurement and monitoring of a comprehensive continuum of care for maternal health in South Africa, with implications for application in other low- and middle-income countries (LMICs).

Methods: A sequential exploratory mixed methods study was conducted. It consisted of a systematic review and critical interpretive synthesis of evidence across LMICs; a review of potential indicators across multiple data sources in South Africa; key informant interviews with experts in relevant sectors; and development and testing of a composite index for tracking performance, using indicator data from the North West province and its four districts in the period 2013-2017. The composite index was termed the *comprehensive continuum of care for maternal health index*, or C₃MH index. The qualitative and quantitative findings were integrated through a triangulation protocol and an analytical framework for measurement and monitoring of the continuum of care for maternal health in South Africa and LMICs was proposed. The proposed approach was explained using concepts from complex adaptive systems and critical realist theory.

Results: The adequacy model for the continuum of care was proposed, which guided holistic measurement of aspects of service provision and multidimensional quality of care in maternal health. Adequacy also informed the four-dimensional C₃MH index, which encompasses indicators of i) health service access and utilization, ii) quality of care, iii) linkages of care and iv) the social determinants of health. The study identified 39 potential indicators from health and non-health sector sources that can be used to monitor interventions along the continuum of care. These indicators were used for comprehensive performance assessment and to make service provision and measurement recommendations for the health system in the North West

province and its districts. Due to data quality and availability issues in the North West, only 25/39 recommended indicators were assessed. Key informant interviews also helped to evaluate the validity, relevance and feasibility of indicators and the continuum of care framework. The interviews supplement evidence in the literature that characterized the measurement gaps on the CoC and made recommendations for future implementation and monitoring of the framework.

The provincial C₃MH index was robust and showed a steady increase at provincial and district level between 2013 and 2017, pointing to general improvements in service provision over that period. Performance was also ranked across the four districts over time, and the index was correlated with institutional maternal mortality rates ($r_s=-0.90$, 90% CI = (-1.00, -0.25)) at provincial level and the Human Development Index ($r=0.97$, 95% CI = (0.63, 0.99)). The analytical framework for the continuum of care identified ten (10) thematic areas for the measurement and monitoring of the continuum of care, which encompassed conceptualization, performance tracking and evaluation of gaps.

Conclusion: These results showed that a standard measurement and monitoring approach for the continuum of care for maternal health is feasible to develop for the South African context. The proposed set of indicators and the C₃MH index were used to track performance and identify gaps at the subnational level in South Africa. These gaps were related to service provision and monitoring and evaluation of the continuum of care. Both qualitative and quantitative approaches were necessary to gain understanding of the phenomenon of continuum of care, assess performance and validate indicators, and make recommendations for maternal health research and practice. The analytical framework developed in this study provided thematic recommendations that can guide adaptation of the proposed standard approach within other LMIC contexts. Future research can evaluate the implementation of this approach in other provinces and districts in South Africa, as well as other LMICs.

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I would like to acknowledge my main supervisor Prof. Lucia Knight for her guidance throughout this research and thesis writing. Thank you, Prof. Knight, for taking me on as a student before my ideas were even solidified, and for your calm guidance when I felt overwhelmed or stuck. Thank you for the quick turnaround times, and for sustained and high-quality engagement with my work throughout the years. Under you I have learned what it means to be a researcher and future supervisor, and I hope to carry that legacy forward.

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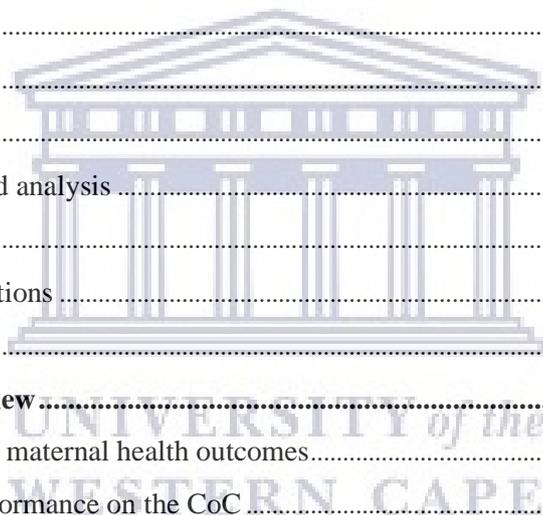
I am thankful to the School of Public Health at UWC for feeling like a family and being a safe and enabling environment for sharing ideas, collaborating, and growing as a researcher. Thank you to Ms. Corinne Carolissen for the administrative support and advice, and for being a friendly face to a new PhD student in 2016. Thank you to my fellow PhDs for giving me a sense of friendship and community and engaging with my ideas, and the rest of the faculty for their interest and feedback on my work during journal clubs and other forums.

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- With gratitude, Mamothena.

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Declaration

I declare that this work '**Development of an approach for measurement and monitoring of the continuum of care for maternal health in the South African health system**' is my own work. I declared that this work has not been submitted for any degree or examination in any other university, and that all sources I have used or quoted have been indicated and acknowledged by complete references.

Student: Mamothena Carol Mothupi



Date: 30/11/2020



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Dedication

This work is dedicated to my late father, Tona David Mothupi (1955 – 2001), for the ever-lasting impression he has made on me to always reach for my fullest potential. We did it, Papa.

Equally, this work is dedicated to my husband, Steve Marwa Machage, for being a pillar and not letting me quit. This PhD is our third baby.

A special heartfelt dedication to my children Mwita and Neo, for being my balance, joy, and comfort.



Acronyms/Abbreviations

ANC – Antenatal Care

ARV – Antiretroviral

CAS – Complex Adaptive System

CoC – Continuum of Care

CIS – Critical Interpretive Synthesis

CSDH – Commission for the Social Determinants of Health

C₃MH – Comprehensive Continuum of Care for Maternal Health

DPME – Department of Planning, Monitoring and Evaluation

DHIS – District Health Information System

EmOC – Emergency Obstetric Care

GHS – General Household Survey

HIV – Human Immunodeficiency Virus

HPV – Human Papillomavirus

IMPAC – Integrated Management of Pregnancy and Childbirth

LCHD – Lifecourse Health Development Framework

LMIC – Low- and Middle-Income Country

LQAS - Lot Quality Assurance Sampling

MCH – Maternal and Child Health

MMR – Maternal Mortality Ratio

MNCH – Maternal, Newborn and Child Health

M&E – Monitoring and evaluation

MTEF – Medium Term Expenditure Framework

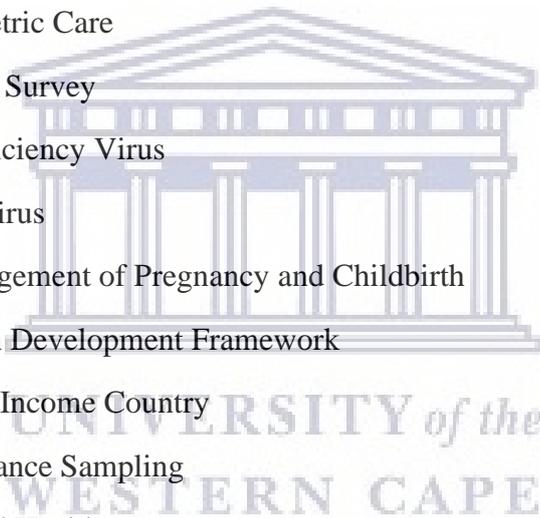
NCCEMD – National Committee for the Confidential Enquiry into Maternal Deaths

NIDS – National Indicator Data Set

OECD – Organization for Economic Cooperation and Development

PMNCH – The Partnership for Maternal Newborn and Child Health

PNC – Post Natal Care



SA – South Africa

SBA – Skilled Birth Attendance

SDGs – Sustainable Development Goals

STIs – Sexually Transmitted Illnesses

UN-DESA - United Nations Department of Economic and Social Affairs

WHO – World Health Organization



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Chapter 1 - Introduction

1.1 Background

This thesis describes the development of a measurement and monitoring approach for the continuum of care for maternal health in South Africa as well as its implications for application in other low- and middle-income countries (LMICs). The continuum of care (CoC) is a public health framework for comprehensive and integrated delivery of preventive, promotive and curative services at different levels of the health system and across the life-cycle of health needs (de Graft-Johnson et al., 2006; Kerber et al., 2007; The Partnership for Maternal, Newborn and Child Health (PMNCH), 2011). The concept applies to prevention and control of any disease and has been studied in HIV care (Layer et al., 2014; McNairy & El-Sadr, 2012), cancer (Taplin et al., 2012) and maternal, newborn and child health (MNCH) (Boerma et al., 2018; Kerber et al., 2007). This thesis focuses on the continuum of care for maternal health, using a framework proposed for maternal, newborn and child health by Kerber et al. (2007) (Figure 1).

In maternal health, the CoC refers to the timely delivery of pre-conception, antenatal, delivery, and postnatal care services provided within the family or community context and the health system (de Graft-Johnson et al., 2006; Kerber et al., 2007). The Kerber definition of the CoC is:

The continuum of care for maternal, neonatal and child health requires access to care provided by families and communities, by outpatient and outreach services and by clinical services throughout the lifecycle, including adolescence, pregnancy, childbirth, the postnatal period, and childhood. Saving lives depends on high coverage and quality of integrated service-delivery packages throughout the continuum, with functional linkages between levels of care in the health system and between service-delivery packages, so that the care provided at each time and place contributes to the effectiveness of all the linked packages (Kerber et al., 2007, p1359).

The Kerber framework presented in Figure 1 illustrates key evidence-based interventions for improving MNCH in LMICs.

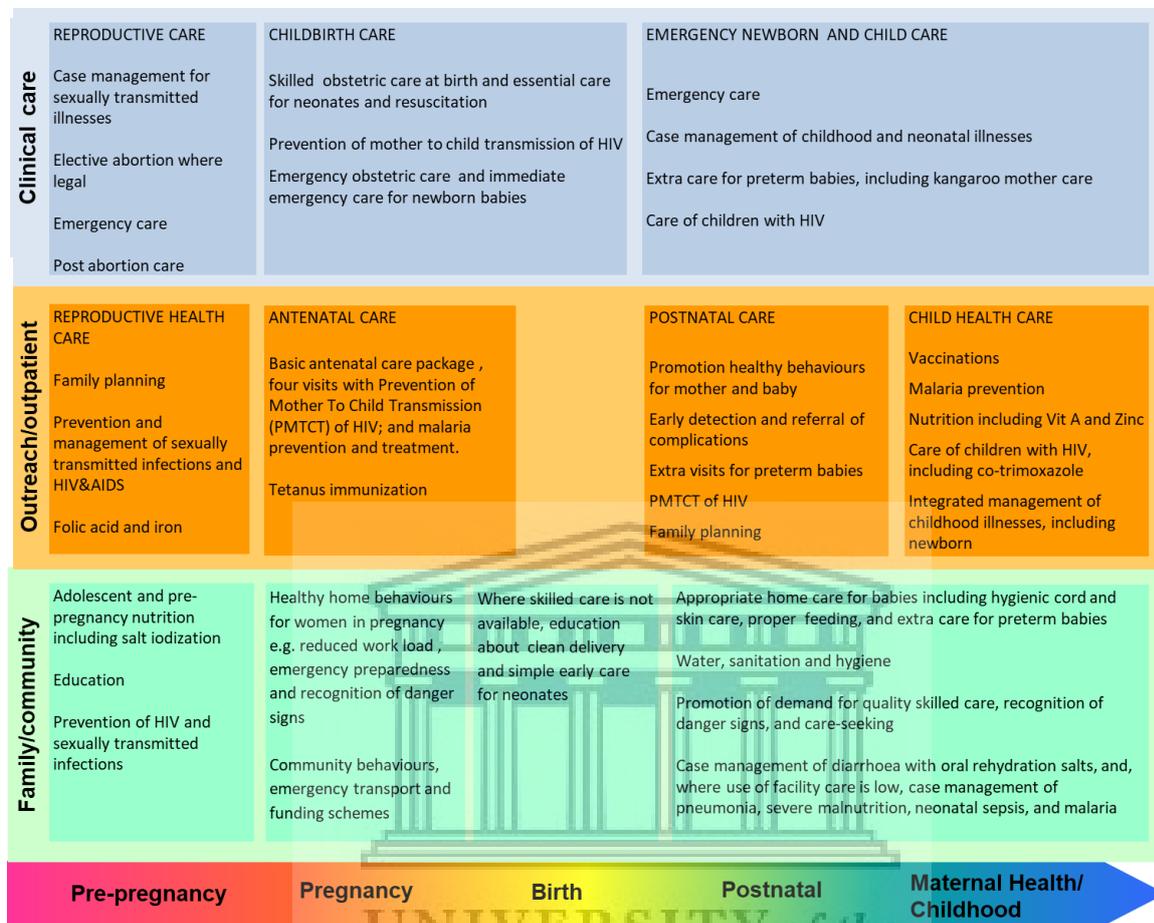


Figure 1: The public health framework for the continuum of care for maternal, newborn and child health in low and middle income countries, developed by Kerber et al. (2007).

According to Figure 1, key maternal health interventions begin with health promotion and prevention services at the family or community level. These include education, reduced workloads, availability of emergency transport, and water and sanitation. These interventions highlight the importance of the social determinants of health to maternal health outcomes (Khanna & Sri, 2020). At the outreach or outpatient level of the health system, women should have access to reproductive health, antenatal care, and postnatal care services. At the in-patient facility level, key clinical interventions include reproductive health care (e.g. elective

abortions) and childbirth care (e.g. basic and emergency obstetric care). The Kerber framework is aligned with key evidence based essential interventions for reproductive and maternal health proposed by the World Health Organization (World Health Organization (WHO), 2014a).

South Africa, like other LMICs has adopted the CoC framework to improve primary care and MNCH outcomes (Bradshaw et al., 2008; Department of Health, 2015; Department of Health, 2012). The Kerber framework has subsequently been adapted to the South African context by health system actors in the country, to better reflect priorities for intervention in the country (Bradshaw et. al., 2008) (Figure 2). The South African framework contains similar interventions as the Kerber framework and outlines intersectoral factors at the family/community level. These are services and interventions that are acted upon by other sectors, sometimes in collaboration with the health system, but impact maternal health (Bradshaw et al., 2008). The South African framework also delineates service provision within a primary or district health system context, with clinical functions defined for district hospitals, outpatient, and maternity units (Figure 2).

While the framework for South Africa has been defined, there is a lack of integration in the current Strategic Plan for Maternal, Newborn, Child and Women's Health and Nutrition (2012-2016) (Department of Health, 2012e), as well as other performance planning documents (Department of Health, 2017a, 2018a; Department of Health, 2018; North West Department of Health, 2017). There is thus inadequate evidence of how the CoC approach is integrated in South African policy and planning to improve maternal health outcomes. The Department of Health has set a goal to improve monitoring and evaluation of MNCH service delivery (Department of Health, 2012). The current approach in South Africa focuses on a limited set of programme indicators (Department of Health, 2018a; Department of Health, 2018) and clinical factors related to maternal deaths through the maternal death audit process (National

Committee for the Confidential Enquiry into Maternal Deaths (NCCEMD) 2014; NCCEMD & Department of Health, 2016; Pillay & Barron, 2018). This monitoring approach misses a comprehensive multisectoral perspective on factors that impact maternal health outcomes (Chopra, Daviaud, et al., 2009; Coovadia et al., 2009; Klazinga et al., 2001; Pillay & Barron, 2018). This is significant because a large number of maternal deaths occur outside of health facilities (Pillay & Barron, 2018) and maternal morbidity and mortality prevention needs a broad approach not restricted to clinical services (Mwaniki et al., 2016; Pacagnella et al., 2012).

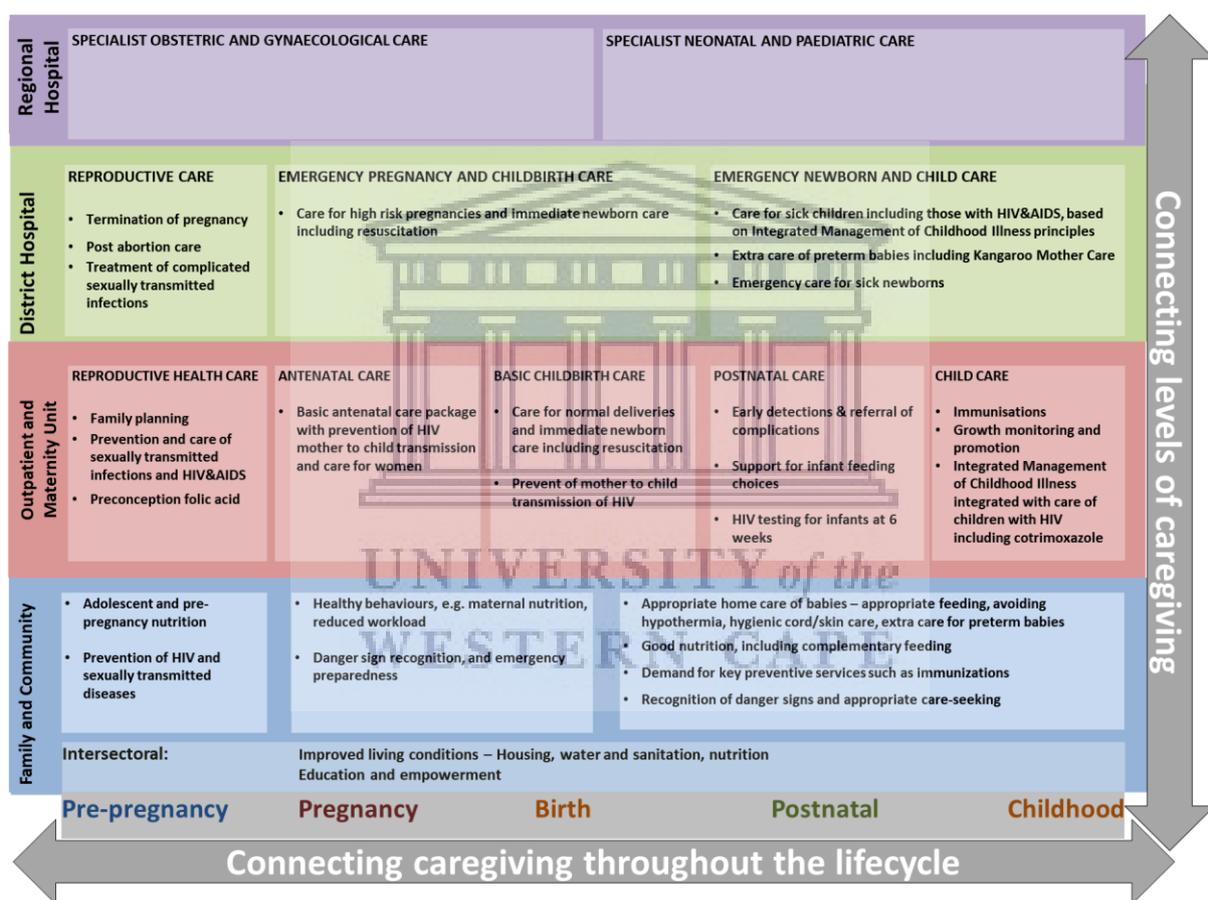


Figure 2: The continuum of care framework for maternal, newborn and child health in South Africa (Bradshaw et al. 2008)

There are inadequacies in measurement and monitoring of the CoC in other LMIC contexts as well. The monitoring approach often used by researchers depends on a limited set of indicators

that are used to do cross-country comparisons of public health performance (Barros & Victora, 2013; Boerma et al., 2008; Boerma et al., 2018b; Victora et al., 2005, 2012; Wehrmeister et al., 2016). These basic indicators include family planning, antenatal care, skilled delivery, and postnatal visits. There is little or no focus on the social determinants of health. Studies also lack a comprehensive and multisectoral perspective, mainly focusing on the triad of antenatal, birth and postnatal care (Akinyemi et al., 2016; Ashish et al., 2011; Rai, 2014; WenJuan & Hong, 2013; Yeji et al., 2015). Therefore, the CoC is not an adequately operationalized concept in research and performance planning and monitoring in South Africa and other LMICs. The research in this thesis aims to understand these gaps in-depth and propose an approach for comprehensive measurement and monitoring of the CoC for maternal health in South Africa, with potential application to other LMICs.

1.2 Study rationale and motivation

The CoC for maternal health is an understudied phenomenon and underutilized strategy in South Africa. In the country's current monitoring approach, there is already a lack of a localized decision making for primary care strengthening (Department of Health, 2017b). This means current frameworks for monitoring service delivery do not adequately reflect sub-national contexts and their needs. This is in contrast to the health system goal to focus on greater decentralisation and decision making at lower levels of care (Bam et al., 2013; Chopra et al., 2009; Coovadia et al., 2009; Pillay & Barron, 2011; Schneider et al., 2018). Additionally, one of the strategic goals in South Africa is to develop and implement comprehensive service delivery frameworks across the continuum of reproductive, maternal, newborn and child health and nutrition (Department of Health, 2012). To enact a comprehensive service delivery framework, a broad set of indicators are needed to monitor it. Therefore, research is needed to

explore how comprehensive approaches can be monitored, particularly at sub-national level to support decision-making in service delivery.

There are also knowledge gaps about why the CoC is underutilized in South Africa and how this can be remedied. To address this gap, insight is required on stakeholders' perspectives on the framework and its perceived utility for policy and planning. Stakeholder consultation and input is important for any research and implementation of measurement tools, as it improves their validity and uptake.

With the interest in improving the use of the CoC framework, there is also a need to propose a feasible measurement and monitoring approach that can be used by countries. This study explores the use of existing data to achieve this goal. The use of existing data reduces the reporting burden of new indicators and creates more public health intelligence out of available data (Department of Health, 2011a; Mutale et al., 2013). For the non-health sector components of the continuum, there is a need to devise an approach for their integration into performance measurement. In South Africa, non-health system data is often reported alongside health system indicators but there is a lack of assessment of collective performance (Day et al., 2018; Day & Gray, 2017). The CoC framework provides the opportunity to address this lack of integration and can inform a new analytical approach that addresses current gaps. The analytical approach should include composite indices because the indicators across the CoC are varied and numerous. The composite index is an effective tool for summarizing indicators and providing easy tools for performance monitoring (Kumar et al., 2013; Victora et al., 2005; Wehrmeister et al., 2016). Thus, composite indexing is expected to improve the feasibility of the proposed measurement and monitoring approach, making it useful for inclusion in policy and planning documents.

1.3 Aim and Objectives

Aim

This study aims to develop an approach for comprehensive CoC performance measurement and monitoring in South Africa, with potential application for other LMICs.

Objectives

1. To systematically synthesize evidence on CoC measurement and monitoring approaches in South Africa and other LMICs
2. To review and select potential indicators for interventions across the CoC for maternal health using a variety of data sources in South Africa
3. To describe stakeholders' perspective of the proposed indicators for the CoC for maternal health in South Africa
4. To describe current (for the period 2013-2017) CoC performance using a comprehensive set of indicators within a sub-national context in South Africa
5. To develop and test a composite index for summarizing indicator performance across the CoC for maternal health in South Africa
6. To synthesize an analytical framework for measurement and monitoring of the CoC for maternal health in South Africa and other LMICs

1.4 Theoretical framework

The theoretical framework for research on measurement and monitoring of the CoC will support the methodological approach used and the interpretation of findings. It consists of the epistemological and ontological basis of the research, which is encompassed by critical realist theory. It also supports the propositions made regarding the understanding of the CoC as an outcome of health system performance, which is largely informed by complexity thinking.

Understanding the continuum of care as a performance outcome: complexity theory

The starting point for the research is the understanding of CoC as a measurable phenomenon and outcome of health system performance, which like other performance indicators can be monitored over time. To support this proposition, a complex adaptive systems lens is adopted.

Complex adaptive systems (CAS) are living systems whose elements interact in dynamic ways to produce non-linear outcomes (Begun et al., 2003; Plsek & Greenhalgh, 2001). The definition of complex adaptive systems used in this study is:

“Complex” implies diversity – a wide variety of elements. “Adaptive” suggests the capacity to alter or change – the ability to learn from experience. A “system” is a set of connected or interdependent things. In a CAS, the “things” are independent agents. An agent may be a person, a molecule, a species or an organization, among many others. (Begun et al. 2003, p255)

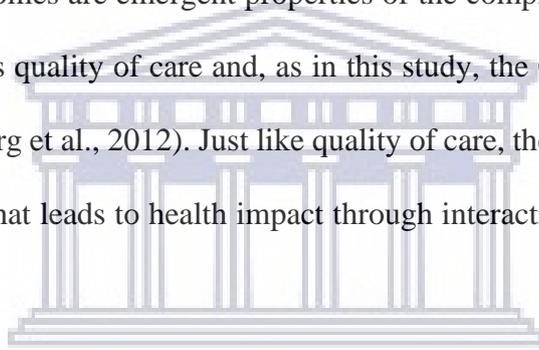
The definition of CAS contrasts with fixed or mechanical views of health systems that aim to create predictable outcomes from interventions. The health system is considered a CAS because it is an open system influenced by its context, whose behaviour is determined by feedback loops between its interacting agents, and where outcomes of actions are not always consistent or predictable (Atun, 2012). The boundaries of the health system are thus redefined by CAS theory and include the input of other sectors if the primary intent is to address health outcomes (Murray & Frenk, 2000; Plsek & Greenhalgh, 2001). The boundaries of the system depend on actions undertaken within a particular context to address outcomes (Zachariadis, Scott, & Barrett, 2013a). Thus “membership” of an agent in a CAS can change from time to time (Plsek & Greenhalgh, 2001). In this thesis, a broad view of the health system is thus

adopted, as the CoC framework incorporates the role of other sectors addressing the social determinants of maternal health outcomes (Figure 1 and Figure 2).

CAS exhibit features such as *dynamism, entanglement and emergence* that are relevant to the understanding of the CoC and its relationship with maternal health outcomes (Begun et al., 2003). In fixed systems, a change in one element of the system or actions of an agent leads to a predictable sequence of events and outcomes. Thus, the introduction of an intervention along the continuum would lead to an improvement in maternal health outcomes. In dynamic systems, however, impact on outcomes cannot be predicted by mere introduction of new interventions (Paina & Peters, 2012). In theory, the dynamic interactions of health and non-health system agent actions and interventions are expected to have a differential impact on the level of effectiveness of CoC. This dynamism means that the impact of the continuum on maternal health outcomes may not be linearly predicted. However, in certain instances CASs can exhibit linear behaviour – i.e. when a distant perspective is taken over a short period of time. This is due to the orderliness of complex systems when observed from certain perspectives (Eoyang et al., 1998). During this research, the potential linear association between performance on the CoC and maternal health outcomes during the study period was investigated.

Entanglement means that the agents in the system are interdependent, interact in non-linear ways, create feedback loops and are influenced by context (Begun et al., 2003). Due to entanglement, the strategies used to address health outcomes must be interrelated (Rwashana et al., 2014). This is in contrast to the vertical program intervention approach used in the health system in South Africa and other LMICs, where interventions across the continuum are often designed and implemented in silos (Ashish et al., 2011; de Graft-Johnson et al., 2006; Department of Health, 2012; Kerber et al., 2007; Malakoane et al., 2020; Musgrove et al.,

2000). There is increasing recognition of the need for integration of previously fragmented services, in order to improve the effectiveness of the health system. Entanglement also means that the causal effect of one agent of the system on outcomes cannot be easily isolated (Atun, 2012; Roux, 2011). This is the case in CoC, where health and non-health sector strategies, community and facility level interventions, and linkages between packages and levels of care collectively determine care outcomes. The causal effect of the continuum is therefore due to the collective action of all its components and not merely isolated interventions with high coverage or quality (Kerber et al., 2007). Outcomes produced by a complex system are emergent, arising from the dynamic interactions of its agents (Begun et al., 2003; Paina & Peters, 2012). Health outcomes are emergent properties of the complex health system, and so are other outcomes such as quality of care and, as in this study, the CoC (Begun et al., 2003; Kruk et al., 2018; Sturmberg et al., 2012). Just like quality of care, the CoC can be regarded as an intermediate outcome that leads to health impact through interaction with other contextual factors.



To further interrogate the context in which health system factors lead to health change, the life-course health development framework (LCHD) within complexity science can be used. The LCHD adopts a longitudinal and highly contextual view of health development, with multiple factors at the individual and societal or environmental level influencing outcomes (Halfon et al., 2014; Halfon & Hochstein, 2002; Russ et al., 2013). The LCHD framework guides health policy in terms of the timing of interventions, the measurement of health outcomes, the organization of services, and investments in public health (Halfon & Hochstein, 2002). Thus, the CoC as an outcome of health system performance interacts with other macro-contextual and individual level factors to influence maternal health outcomes. The importance of the timing of care and organization of services are also reflected in the CoC framework. The

lifecycle orientation of the CoC means that there are multiple intervention points throughout the woman's life where the health system may or may not play a role in her health status. Like the CoC, the life course perspective emphasizes the importance of preventive interventions (and the environment beyond the health system) and a holistic perspective of maternal health determinants (Russ et al., 2013).

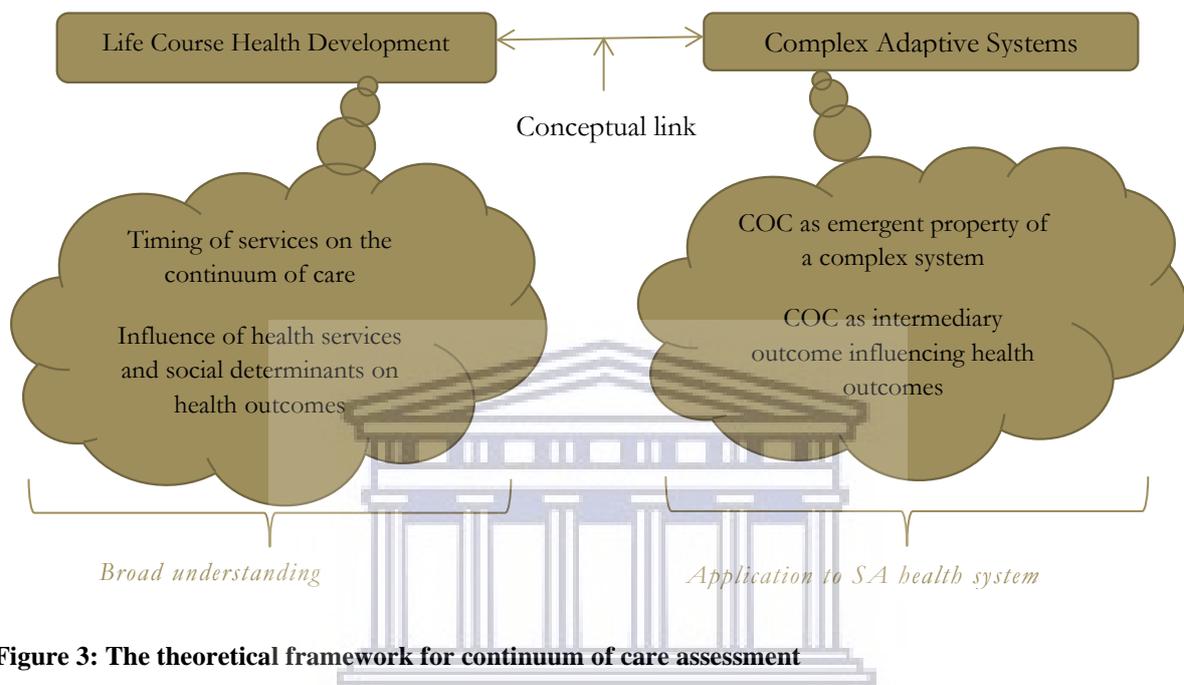


Figure 3: The theoretical framework for continuum of care assessment

Figure 3 shows how the life course and complexity perspectives are related and influence the theoretical understanding of the CoC in this study. For understanding CoC, the LCHD framework highlights the importance of timing of care and interaction of macro-contextual factors, the health system and other structural determinants of health outcomes. A CAS perspective helps to frame how the CoC may emerge as an outcome of a complex system. Framing the CoC as an outcome of the system helps understand why it should be measured and monitored and justifies the investigation of its relationship with maternal health outcomes. The conceptual links between LCHD and CAS are also well established in the literature (Halfon et

al., 2014; Russ et al., 2013). They are both informed by complexity science, which attempts to understand outcomes of a dynamic, open and adaptive system.

This section has described *why* the CoC can be considered an outcome of the health system which can be measured and monitored over time and assessed for its relationship with maternal health outcomes. This study adopts methods informed by critical realist theory to design research and gain knowledge on *how* the CoC as an outcome can be measured.

Measuring and monitoring the continuum of care outcome: critical realist theory

Once we have understood the CoC as a phenomenon and measurable outcome, we can then outline how to measure and assess it. Key to this assessment is the validation of any proposed concepts and metrics for the measurement and monitoring of the CoC. This speaks to the epistemological and ontological contributions of the research, which in this thesis are appraised via a critical realist lens.

Critical realism is a philosophy of science that posits that reality exists despite of our knowledge of it, and our observations of it are limited by the tools and lenses we adopt to learn about it (Alvesson & Skoldberg, 2009; Bhattacharjee, 2012; Mcevoy & Richards, 2006; Zachariadis, Scott, & Barrett, 2013a). This contrasts with other philosophies of science where objective reality exists and is directly observable (positivism and post-positivism) and those that rely on the subjective experience of agents/actors to describe reality, i.e. the social construction of reality (Alvesson & Skoldberg, 2009). Reality refers to the facts, events or phenomena that have an impact on people, whether seen or unseen, measured or unmeasured.

Critical realism can be distinguished from positivism because it goes beyond describing patterns and associations using mainly quantitative data (Alvesson & Skoldberg, 2009; Zachariadis, Scott, & Barrett, 2013a). The use of a positivist paradigm would restrict this study

to assessment of performance of indicators only. That approach does not provide an understanding of the CoC as a complex phenomenon and does not inform a conceptual approach that is transferrable to other contexts. Critical realism is also distinguishable from social constructivism because it theorizes on objectively defined, instead of socially constructed or subjective phenomena (Alvesson & Skoldberg, 2009; Zachariadis, Scott, & Barrett, 2013a). There is acknowledgement in the critical realist perspective of the role of social reality in production and interpretation of even objective phenomena (Alvesson & Skoldberg, 2009). The CoC can thus be studied using a critical realist perspective as a measurable phenomenon amenable to researcher and expert interpretations.

Ontologically, critical realism introduces three domains of reality in which knowledge can be categorized and understood (Figure 4).

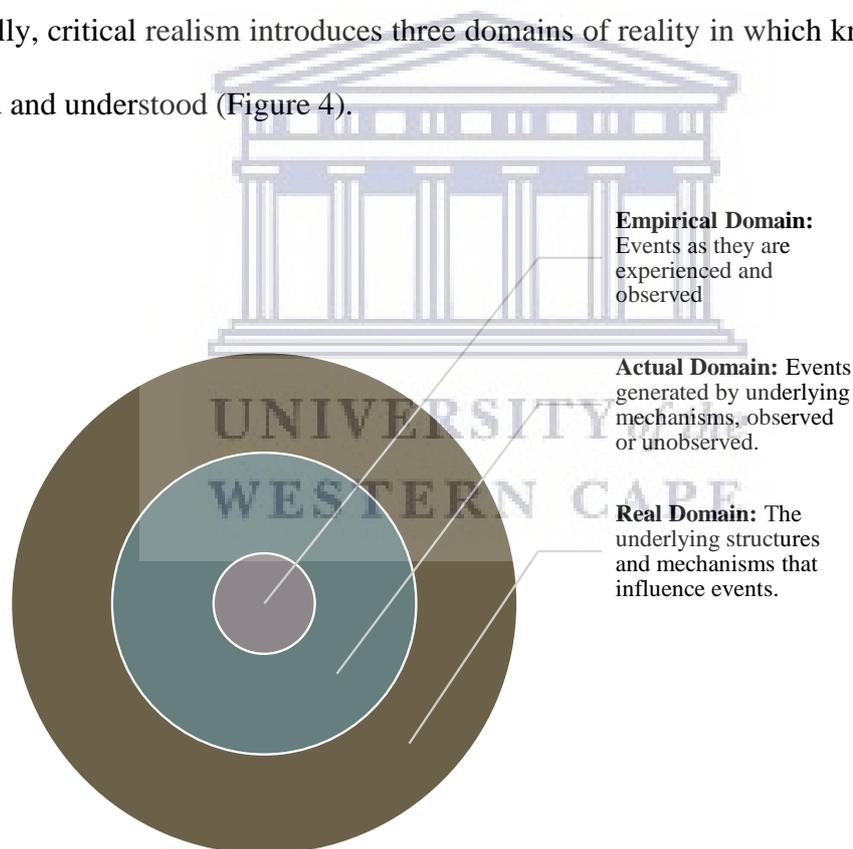


Figure 4 The three domains of reality according to critical realist ontology. (adapted from Zachariadis et al. 2013)

The *real* domain refers to the intransitive, underlying structure and mechanisms of phenomena that gives rise to the events which we may observe (Alvesson & Skoldberg, 2009; Mcevoy &

Richards, 2006; Zachariadis, Scott, & Barrett, 2013b). The *real* realm is thus the “objective” structure of a phenomenon, all of its essential components and its “true form”. A phenomenon like the CoC is thus hypothesized to contain an essential structure that explains its impact on maternal health outcomes. This is posited with acknowledgement that the continuum acts within a broader macro-contextual framework of causation according to the LCHD framework discussed earlier (pages 20-22). What is referred to is the inherent structure of CoC, which results from the different interventions, their quality and level of provision etc., to produce attributable population health outcomes, individual variation in outcomes notwithstanding.

The inquiry thus goes beyond indicators and their monitoring over time, to the interpretation of proposed metrics in a conceptually coherent manner. In this thesis it is argued that as a phenomenon, an impactful state of CoC exists, whether it is observed or not. The Kerber framework illustrated in Figure 1 tries to show what the state encompasses in terms of essential interventions (Kerber et al., 2007). According to critical realist theory, it is possible that there are interventions of the continuum that we are missing. There is already some evidence in literature of the missing component of quality of care in CoC frameworks (Graham & Varghese, 2012), and the Bradshaw framework emphasizes the importance of linkages to care to determine outcomes in the South African context (Bradshaw et al., 2008). More evidence is needed on measurement approaches across CoC studies to assess what they also contribute to our understanding of the continuum. This will give clues about the essential properties of CoC, from which we can base arguments regarding its underlying structure for measurement and monitoring.

The *actual* domain of reality refers to events that emerge out of the interactions of the underlying structure with other factors/conditions in the environment (Mcevoy & Richards, 2006). These events may or may not be observed by researchers/individuals/populations

(Alvesson & Skoldberg, 2009). The actual domain is highly contextual, in that the same underlying mechanisms can produce different events depending on the interactions unique to the environment (Zachariadis, Scott, & Barrett, 2013b). In the actual domain therefore, the CoC is manifested differently depending on the implementation and monitoring of relevant interventions. And the impact on maternal health is also influenced by the interaction of interventions on the continuum with one another and other factors at the individual and environmental level. In this research, the goal is to measure and monitor the CoC comprehensively and assess undermeasured aspects and their implications for system performance in South Africa.

Empirical reality refers to what is observable and measurable by researchers (Alvesson & Skoldberg, 2009; Zachariadis, Scott, & Barnett, 2013). This empirical reality is often the starting point of understanding the underlying mechanisms of phenomena and ultimately unpacking its complexity (Williams & Dyer, 2017; Zachariadis, Scott, & Barrett, 2013a). The empirical domain of reality thus refers to the observable aspects of the CoC. These are interventions currently implemented and monitored by the health system and proposed through research by experts. Because there has been no comprehensive measurement and monitoring of the CoC in LMICs, as stated in the problem statement, it is unknown what can be uncovered in the empirical domain when that perspective is adopted. The purpose of this study is thus to uncover the comprehensive set of indicators in the empirical domain and to use it to inform explanations involving the underlying structure of CoC and its undermeasured aspects.

Critical realism and complexity

The ideas of critical realism are intertwined with the complexity concepts discussed earlier in this section, because causality is not regarded as linear and predictable but dependent on

contextual factors that act on our defined structures or mechanisms (Alvesson & Skoldberg, 2009). Reality itself is an “open and complex system where other mechanisms and conditions also exist” (Zachariadis, Scott, & Barrett, 2013b). This means the health system can produce an effective CoC as an outcome, as a result of complex interactions within the system. In addition, it can interact in dynamic ways with other individual and environmental factors to influence health outcomes. The health system thus forms an open system within an open system and interacts dynamically with all other societal factors/systems to influence health and related outcomes. Through dynamic interactions, there emerges some level of CoC that may or may not be effective in its influence on maternal health outcomes. Due again to complexity in causation, the research design to be adopted in this study cannot define an effective level of CoC, one which is guaranteed to always produce positive maternal health outcomes. But a structure that explains its performance can be investigated, and to some extent its correlation with maternal health outcomes explored.

1.5 Methodology

This section describes the research design and setting for understanding the measurement and monitoring of CoC for maternal health in South Africa and other LMICs.

1.5.1 Research Design

The critical realist paradigm influences the use of a mixed methods research approach in this study. Mixed methods research is a pragmatic approach that allows for use of both qualitative and quantitative data to understand the phenomenon under study (Creswell, 2003). Interventions on the continuum are measurable and can be monitored with indicators therefore, quantitative data is essential to track performance over time and place. However, because the continuum is also understood and implemented differently across contexts, qualitative data can

characterize available evidence and integrate stakeholder perspectives. Inclusion of both forms of data allows for the development, use and interpretation of metrics for the CoC for maternal health.

According to Zachariadis et al. (2013) mixed methods approaches are particularly suitable for research that adopts a critical realist paradigm. As discussed earlier, a critical realist perspective necessitates a methodology where empirical evidence is used to give clues about the underlying structure of a phenomenon (Zachariadis, Scott, & Barrett, 2013a). The approach is called retrodution and “*allows researchers to move between the knowledge of empirical phenomena as expressed through events to the creation of explanations (or hypothesizing) in ways that hold “ontological depth” and can potentially give some indications on the existence of unobservable entities*” (Zachariadis, Scott, & Barrett, 2013b). The role of quantitative methods is to summarize, describe and correlate events, measures or outcomes. Qualitative studies provide explanations regarding relationships of objects under study, isolate contextual factors and describe necessary conditions for outcomes to occur (Zachariadis, Scott, & Barrett, 2013a). There is therefore a synergy between the critical realist paradigm and the mixed methods research used in this study.

The mixed methods strategy used was the *sequential and exploratory*, which means that qualitative and quantitative phases of research build on one another to uncover more about the phenomenon under study (Creswell, 2003). This strategy is illustrated in Figure 5.

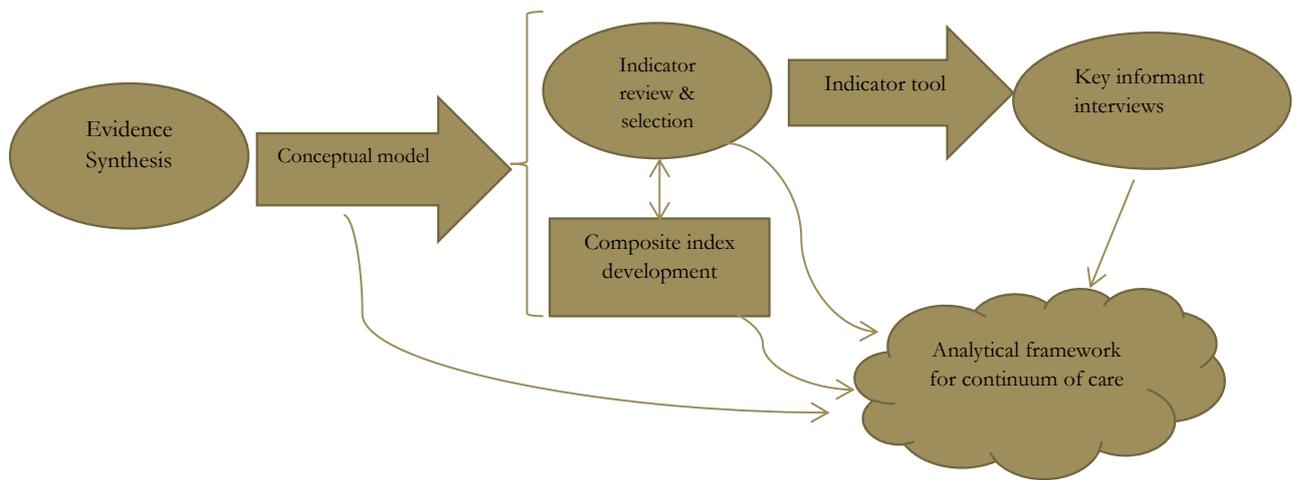


Figure 5: The sequential, exploratory mixed methods strategy leading to the development of an approach for measurement and monitoring of the continuum of care for maternal health

The first phase of the sequential, exploratory research was a qualitative systematic review and critical interpretive synthesis to synthesize current evidence on CoC measurement in LMICs. The outcome of a critical interpretive synthesis is an emerging construct(s) or conceptual model which offers a second order interpretation and thus more insight, of current evidence (Dixon-Woods et al., 2006; Flemming, 2010). The emerging constructs from this study informed the subsequent research stages, which were the review of indicators and development of a composite index for quantitative performance measurement. Part of the evaluation of the indicator tool developed from the review was a qualitative, stakeholder consultation process through key informant interviews. All the outputs of the studies in this research contributed to the development of an analytical framework, which consisted of both qualitative and quantitative components.

1.5.2 Data collection and analysis

This section summarizes the data collection and analysis approaches used in this thesis, described in more detail in the relevant chapters.

- a) The evidence synthesis relied on both qualitative and quantitative literature for the measurement, assessment and monitoring of the CoC in LMIC contexts (Chapter 3). The process for the selection of literature was systematic. After undergoing quality appraisal, selected literature was analysed qualitatively (by critical interpretive synthesis) using Atlas.ti 8.4. This stream of work reflected the first objective of the study, which was to “systematically synthesize evidence on CoC measurement and monitoring approaches in South Africa and other LMICs” (page 17).
- b) Indicators for the CoC were sourced from the health information system and household surveys and selection was guided by a document review of established policies and authoritative guidelines and reports (Chapter 4). Indicator data was recorded, reviewed and appraised in MS Excel. This approach reflected the fulfilment of the second objective of this study, which was to “To review and select potential indicators for interventions across the CoC for maternal health using a variety of data sources in South Africa” (page 17).
- c) Semi-structured key informant interviews were conducted in order to understand and evaluate the validity, relevance and feasibility of the selected indicators (Chapter 5). These interviews were one of the qualitative tools used to explore phenomena in depth and give clues about underlying mechanisms and structure (Zachariadis, Scott, & Barrett, 2013a). Data were entered into Atlas.ti 8.4 and analysed thematically. This approach fulfilled the objective: “To describe stakeholders’ perspective of the proposed indicators for the CoC for maternal health in South Africa” (page 17).

- d) Indicator measurement and performance tracking involved a secondary analysis of quantitative data from the North West province in South Africa for the period 2013-2017 (Chapter 6). These data were sought from both the district health information system and household surveys. Data was extracted and analysed in MS Excel, R and STATA. This approach fulfilled the objective of the study: “To describe current (for the period 2013-2017) CoC performance using a comprehensive set of indicators within a sub-national context in South Africa” (page 17).
- e) The development of the composite index relied on mathematical and statistical methods using established guidelines and relevant literature (Barclay et al., 2019; Booysen, 2002a; Organization for Economic Cooperation and Development (OECD), 2008). The index was tested using the same secondary data from the North West province and its districts in South Africa for the period 2013-2017. Secondary data was extracted and analysed in MS Excel, R and Stata. This approach fulfilled the objective of the study: “To develop and test a composite index for summarizing indicator performance across the CoC for maternal health in South Africa” (page 17).
- f) The analytical framework was developed via an integrative analysis of the findings from the qualitative and quantitative studies conducted for this thesis, using a triangulation protocol. An important component of mixed methods research is the integration/triangulation of findings to address the research question (Creswell, 2003). This study used a triangulation protocol as proposed by (Farmer et al., 2006), applied to mixed methods study. The triangulation protocol was formulated and analysed in MS Excel. This technique fulfilled the objective: “To synthesize an

analytical framework for measurement and monitoring of the CoC for maternal health in South Africa and other LMICs” (page 17).

1.5.3 Study setting

The study encompasses LMICs, South Africa, the North West province and its four districts as contexts. The analysis of the conceptual dimensions of the CoC is relevant to and is based on literature from LMICs. For indicator review and selection, the study focused on South Africa. South Africa has a wealth of health information and survey data relevant to the CoC and is where the researcher and author of the thesis is based. The researcher thus understands the health system and public health context and has the necessary networks to facilitate data acquisition and key informant interviews. The indicator selection data are representative nationally, to enable comparisons of performance across different geographical areas in the country. To gain deeper insight into the CoC performance and test the index, the narrower context of the North West province (and its four districts) was selected. The North West province was selected because it was an early adopter of programs to extend maternal health promotion and preventive services (Schneider et al., 2018) and therefore was expected to have data on CoC relevant services.

1.5.4 Validity considerations

Validity in critical realist research is focused on the quality of design, measurement or analysis and inferences about phenomena and their underlying structures (Zachariadis, Scott, & Barrett, 2013a).

For quantitative research, it is important to consider external, construct and inferential validity of findings in order to make claims and recommendations. Applied to the current study, these concepts imply that (Venkatesh et al., 2013; Zachariadis, Scott, & Barrett, 2013b):

- *External validity (as part of design validity)*: the composite indexing approach can be used for comparative analysis in different contexts in South Africa, that is, it is generalizable
- *Construct validity (as part of measurement validity)*: the indicators and index measure the CoC and its component interventions adequately
- *Inferential validity*: the statistical relationships between the composite index and maternal health and related outcomes are tested.

In the qualitative realm, it is important to consider credibility, transferability and plausibility in the design, analysis, and inferences of the study. Applied to the current study, these concepts mean:

- *Credibility*: the evidence synthesis adequately reflects the field of knowledge and supports the development of robust conceptual models
- *Transferability*: The conceptual model and analytical framework for CoC can be applied to other SA and LMIC contexts not covered by the study
- *Plausibility*: the key informant interviews assess indicator suitability and utility to policy and planning in South Africa.

The qualitative and quantitative components are mutually informative in terms of the validity of the research.

1.6 Outline of the thesis

This section presents the outline of the thesis and demonstrates how the subsequent chapters are interlinked.

- a) **Chapter 2** constitutes a broad literature review that explains in detail concepts related to the measurement and monitoring of the CoC for maternal health. In the literature

review, the relevance of current evidence on maternal health determinants, as well as the role of the CoC in current policy and practice, are explored. The CoC is explored in terms of its relevance to monitoring and evaluation, comprehensive service delivery, and multisectoral collaboration for the social determinants of health. The exploration of this literature contributes to a comprehensive understanding of the relationship between the CoC framework and other established service delivery concepts and frameworks. The review helped to situate the CoC within current literature and demonstrated in more detail the knowledge gaps to be addressed by the current research.

- b) **Chapter 3** presents the systematic review of current evidence for measurement of the CoC in LMICs. The systematic review was essential to rigorously synthesize current evidence, identify gaps and propose a new way forward. It synthesized the variety of existing approaches into a coherent model for improved measurement of the CoC. This model also guided the review and assessment of indicators for the CoC in South Africa (Chapter 4) and offers an approach that can be adapted to other countries. The proposed conceptual model of adequacy of the CoC is also applied in later chapters in this thesis, which deal with performance indicators for the CoC (Chapter 6). Chapter 3 is published in *BMC Health Services Research* as a research article titled “**Measurement approaches in CoC for maternal health: a critical interpretive synthesis of evidence from LMICs and its implications for the South African context**” (2018)
- c) **Chapter 4** is a review and selection of indicators to monitor the CoC, based on information sources in the health and non-health sector in South Africa. The proposed set of indicators was guided by the adequacy conceptual model developed in Chapter 3, the Kerber framework (Bradshaw et al., 2008; Kerber et al., 2007b), as well as other frameworks for social determinants and quality of care (Brizuela et al., 2019a; CSDH

et al., 2008; Department of Health, 2018b; Department of Health, 2011; Solar & Irwin, 2010; PMNCH, 2011; Tunçalp et al., 2015; WHO, 2011; WHO, 2018). The indicator set serves a dual purpose: i) it provides guidance on how the CoC can be monitored in South Africa and ii) it identifies areas where measurement can be improved to better monitor service provision. The indicator set also guided the development of a composite index for performance tracking in Chapter 6 and was appraised by experts in Chapter 5. The findings of the review are published as a peer-reviewed research note in *BMC Research Notes*, titled “**Review of health and non-health sector indicators for monitoring service provision along the CoC for maternal health**” (2020).

d) **Chapter 5** is an evaluation of the indicators proposed in Chapter 4 using key informant interviews conducted with experts in maternal health, the CoC and monitoring and evaluation in health and non-health sectors. This research helped to expand the understanding of the CoC measurement in the country and reflected on the validity, feasibility and relevance of the framework and indicators. The experts revealed gaps in measurement and made recommendations for future improvement of indicators and the framework. Chapter 5 is published in *Health Policy Research and Systems*, titled “**Improving the validity, relevance and feasibility of the CoC framework for maternal health in South Africa: a thematic analysis of experts’ perspectives**” (2020).

e) **Chapter 6** details the methodology and findings of the composite index development, used to summarize the performance of the indicators proposed in Chapter 4. The index was tested through secondary analysis of data from the North West province, over the period 2013 to 2017. The chapter presented the performance trends in the province and its four districts, as well as areas of service improvement on the CoC.

Recommendations for health information system improvements to support more accurate estimation of the composite index were made. The chapter demonstrated how the composite index can be developed and tested, thus providing guidance for application to other LMICs. The findings of the chapter contribute to the synthesis of the analytical framework in Chapter 7. Chapter 6 is a manuscript that has been submitted and is currently under editorial review at *PLOS One*, titled “**Development and testing of a composite index to monitor the continuum of maternal health service delivery at provincial and district level South Africa**” (May 2020).

- f) **Chapter 7** is a synthesis of the analytical framework for measurement and monitoring of the CoC in South Africa and other LMICs. The analytical framework highlights conceptual and empirical tools and methods developed in Chapters 3-6, providing guidance on the implementation and interpretation of the proposed approach. Thus, through the analytical framework, the approach for measurement and monitoring of the CoC proposed in this research can be useful to researchers, policy- and decision-makers likely to implement it. The Chapter also demonstrates the integration of mixed methods findings through a triangulation protocol, thus contributing to the growing methodological knowledge base. Chapter 7 is presented as a manuscript submitted in *Family Medicine and Community Health*, titled “**An analytical framework for assessing an adequate CoC for maternal health**” (November 2020).
- g) **Chapter 8** is a discussion of the research findings in Chapters 3-7 and places the thesis within the broader maternal health research and practice literature. The discussion focused on a description of findings across the objectives of this thesis. The discussion demonstrated the contributions of the thesis, as well as the limitations and recommendations for future research. In particular, the theoretical contributions of the

study to the measurement and monitoring of the CoC in the future are highlighted. Chapter 8 also includes a conclusion that summarizes the goal and contribution of the research and highlights its novel contributions to knowledge.



Chapter 2 - Literature Review

This chapter presents a brief literature review to describe the concept of the CoC in relation to maternal health outcomes, health system performance and other public health frameworks. It serves to provide an understanding of the role of the CoC in current maternal health, public health and health system literature. The literature review complements the more detailed systematic review on measurement approaches for the CoC (Chapter 3) and background literature presented in each chapter (Chapters 4-7).

The CoC as a framework for maternal health service delivery was proposed as early as 1993 to support efforts for reducing maternal mortality (Kerber et al., 2007). It began with an observation of the importance of linkages between communities and primary care facilities to improve pregnancy outcomes. The concept then grew to include integration of maternal, newborn and child services; access to good quality of care; and structural and social determinants of health (Kerber et al., 2007). Kerber et al. (2007) then derived an all-encompassing definition of the CoC, as introduced in Chapter 1 and the basis for the research and analysis in this thesis. Kerber et al. (2007) also proposed a public health framework for organizing services on the CoC for maternal and child health, relevant to low- and middle-income countries (LMIC).

2.1 Continuum of care and maternal health outcomes

The CoC framework extends the original definition of maternal health as the health of women during pregnancy, childbirth and the postpartum period (WHO, 2016), to include preconception and the period beyond post-partum. This broader view of maternal health is supported by research on the influence of preconception factors on maternal health outcomes

(Bates et al., 2008; Dean et al., 2014; Draper et al., 2014; Firoz et al., 2018; Gillespie, 2018), the life-course perspective (Russ et al., 2013), and sexual and reproductive health services (Department of Health, 2012; Firoz et al., 2018; Kendall et al., 2014). Beyond the postpartum period, maternal mental health is gaining increasing attention in LMICs (Baron et al., 2016). Maternal health is also integrated with child health outcomes in the CoC framework, in order to influence better in public health research, policy and planning (Bradshaw et al., 2008; Kerber et al., 2007; Matthews, 2005).

A maternal health outcome of interest is the maternal mortality ratio, which is the number of deaths per 100,000 live births. South Africa has not seen improvements in the maternal mortality ratio (MMR) to align with the Sustainable Development Goals (SDGs) and the country's target of 100 deaths per 100,000 live births (Department of Health, 2018a). According to 2015 estimates, the MMR in the country was between 138 and 158 deaths per 100,000 live births (Day et al., 2018). The pregnancy related mortality was higher, estimated at 536 per 100,000 live births in 2016 (Department of Health et al., 2019). A frequently used indicator is the maternal mortality in facilities ratio, which is measured from facility data but does not include deaths that occur in the community (Pillay & Barron, 2018). The institutional MMR in the country was 135 deaths per 100,000 live births in 2016 (Pillay & Barron, 2018). The national MMR has only slightly declined since 2005 (WHO, 2014b) and performance should be better based on the level of investment the country makes in ensuring positive outcomes (Pillay & Barron, 2018; Rispel, 2016).

Maternal morbidity is also an important maternal health outcome indicator as mortality rates stagnate and quality of care concerns rise (NCCEMD, 2014; Say et al., 2004, 2009). A focus on maternal morbidity helps identify avoidable factors that can be modified to improve maternal health care (Ghandi et al., 2004). Considering both morbidity and mortality, common

causes of negative maternal health outcomes in LMICs and South Africa are i) haemorrhage, ii) hypertensive disorders, iii) infection, iv) abortion and ectopic pregnancy related complications, and v) other diseases or conditions including anaemia (Say et al., 2014; Souza et al., 2013). South Africa has had a high proportion of maternal deaths contributed by indirect causes, particularly HIV and pre-existing medical conditions (NCCEMD, 2014; Say et al., 2014; WHO, 2014b).

Recommendations to improve maternal health morbidity and mortality in South Africa include; improvement of quality of care, increased coverage of key interventions, healthcare provider training, strengthened community level responses and action on social determinants of health (Bamford, 2012; Chola et al., 2015; Department of Health, 2016; Moodley et al., 2018; NCCEMD, 2014; Pillay & Barron, 2018). These recommendations point to health service access and provision issues at community and health facility level, a lack of coordination in the system and the need for action on social determinants of health by multiple sectors. Regarding the latter, research has identified poverty (Bradshaw et al., 2008; Chersich et al., 2016; Kinney et al., 2010), socioeconomic factors (Garenne et al., 2011; Wabiri et al., 2016), care seeking behaviours (Bradshaw et al., 2008), race (Garenne et al., 2011; Wabiri et al., 2013), geographical area (Garenne et al., 2011; Kinney et al., 2010), education and nutrition (Chola et al., 2015; Firoz et al., 2018; Wabiri et al., 2013) as some of the factors influencing maternal health outcomes in South Africa and other LMICs. These factors are also reflected in the CoC framework as crosscutting issues at the family/ community level.

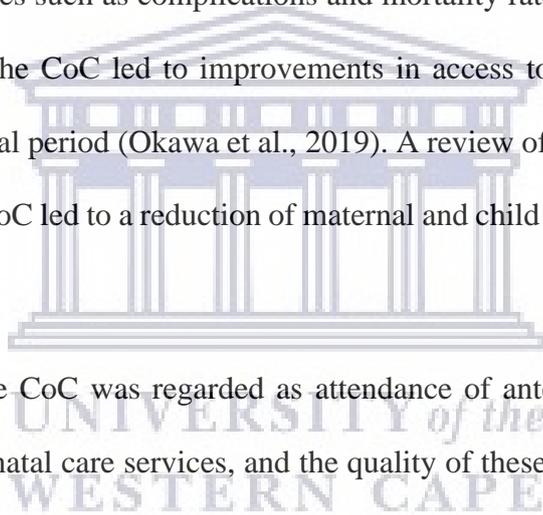
In summary, this section will discuss the state and determinants of maternal health outcomes in South Africa and LMICs. The determinants of poor outcomes include gaps in access and provision of services in the health system and lack of action on social determinants of health across sectors.

2.2 Measuring system performance on the CoC

Performance on the CoC can indicate the system's strength and likelihood of having a positive impact on maternal health. There are various ways in which system performance on the CoC can be measured and assessed, including effectiveness trials, assessment of access to or utilization of individual interventions and quality of care.

In order to test the effectiveness of the CoC on maternal and child health outcomes in LMIC contexts, Kerber et al. (2007) proposed the use of randomized and quasi-randomized trials. In a cluster randomized controlled trial underway in Ghana, access to a CoC is being studied for its effect on health outcomes such as complications and mortality rates (Kikuchi et al., 2015). Recent results show that the CoC led to improvements in access to and quality of care for mothers during the postnatal period (Okawa et al., 2019). A review of other trials showed that effective linkages on the CoC led to a reduction of maternal and child mortality (Kikuchi et al., 2015).

In the Ghanaian study, the CoC was regarded as attendance of antenatal clinic, delivery in facility, utilization of postnatal care services, and the quality of these services (Kikuchi et al., 2015). It does not measure the broad spectrum of interventions on the CoC, unlike the approach adopted for this thesis. A review has shown that preconception factors also improved pregnancy outcomes and neonatal mortality (Dean et al., 2014). Therefore, despite the CoC being measured differently, it is consistently associated with positive health and programme outcomes (Dean et al., 2014; Kikuchi et al., 2015). This is consistent with the claim that each of the interventions on the CoC has a positive impact on maternal and child health outcomes (PMNCH, 2011).



The analysis of system performance on the CoC can shed light on specific service improvements required to ensure positive maternal and child health outcomes. These can lead to increased coverage, better quality of care, reduced inequities, better management of resources, and integration of services (Bamford, 2012; Chopra, Daviaud, et al., 2009; Kerber et al., 2007). Scaling up of interventions across the CoC was linked to maternal, newborn and child lives saved in LMICs (Black et al., 2016). A study in Ghana investigated coverage of services for mother-child pairs and found that only a minority (10%) received the full continuum (Shibanuma et al., 2018). That study recommended action to ensure improved provision of services and address inequalities.

An important area for research is understanding the factors that influence the utilization of the CoC by women. This information enables policymakers to better target groups and improve access to care where needed. The factors that hinder utilization of the CoC are similar across LMICs and necessitate multifaceted interventions across sectors. A study in Cambodia identified quality of care, mother's characteristics and socioeconomic variables as factors that influenced utilization of services along the CoC (Wang & Hong, 2015). Another study in Ghana measured factors associated with completion rates of the CoC (Yeji et al., 2015) and found low completion rates for the continuum. The factors associated with low completion included behaviours and beliefs, lack of transport infrastructure and education levels (Yeji et al., 2015). A Ugandan study found coverage gaps that also pointed to structural (socioeconomic and social determinants of health) and individual factors as challenges to uptake (Roberts et al., 2015).

Quality as a measure of performance across the care continuum is still an area of inadequate research (Graham & Varghese, 2012; Kruk et al., 2018). There is a challenge in LMICs monitoring quality of care, characterized by inadequate research and poor health information

systems (Boerma et al., 2018; Kruk et al., 2018). In a study in Nigeria and India, Marchant et al. (2015) found that while rates of mother-newborn contact with the health system were often high, the quality of care delivered during visits was often low (Marchant et al., 2015). They highlighted the importance of measuring content of care to understand outcomes. A metric to measure contact and content of care is effective coverage, which measures the coverage and quality of interventions in an integrated manner (Ashish et al., 2011; Boerma et al., 2018). However, effective coverage is measured for individual interventions and does not reflect quality along the continuum.

Quality of care is also influenced by health sector and non-health sector factors (Boerma et al., 2018). The WHO has a framework that recommends quality improvement in facilities (WHO, 2016c), but quality of health system outreach services and those provided by other sectors is underexplored. A discourse on quality of the CoC necessitates a consideration of these broad interventions. Maternal mortality audits in South Africa acknowledge the importance of factors that precipitate maternal deaths outside of facilities (Bradshaw et al., 2008; Pillay & Barron, 2018). A WHO policy guide emphasizes multisectoral factors such as quality education and safe drinking water as important determinants of outcomes (WHO, 2014a). The Commission on Social Determinants of Health (CSDH) (2008) also cites the importance of the quality of people's natural environment, housing, water and sanitation, air, and work/labour to support healthy living and well-being. Thus, in this thesis, the issue of quality was considered for both health system interventions and social determinations such as water and sanitation and housing. Consideration of quality goes beyond the availability of resources to issues of safety as well, in order to measure the determinants of outcomes more accurately.

A comprehensive CoC consists of several interventions; therefore, composite indices can be used to summarize performance. Boerma et al. (2008) created a composite coverage gap index

for maternal and child health based on indicators of family planning, maternal and newborn care, immunization, and treatment of sick children. This was an integrated measure, applied to comparison of performance across LMICs, using the limited scope of available indicators. The use of the coverage gap index limited the number of indicators that could be used at the sub-national level, which can reflect context more than indices designed for cross-country comparisons. A similar index, the co-coverage index, includes access to a limited set of 8 indicators for both maternal and child health, but additionally measures access to safe drinking water (Wehrmeister et al., 2016). The co-coverage index was applied by Kumar et al. to monitor maternal and child health performance over time at a sub-national level in India (Kumar et al., 2013). By focusing on the sub-national level and developing a new index, this thesis aims to address this gap in comprehensive monitoring tools to support more localized decision-making.

Another understudied aspect of the CoC is the decision makers' and patients' perspectives and experiences. Patients can provide important insight on care received (Mazor et al., 2016), linkages (Kollen et al., 2011) and defining needs (Cameron et al., 2013) but there is a lack of literature on how women of reproductive age experience the CoC. Moreover, there is a lack of providers' perspective about the experience of providing services on the CoC. If frameworks for system strengthening and service improvement are to be implemented, it is essential to understand stakeholders' perspective of them (Coxon, 2005; Hipgrave et al., 2014; Tsisis et al., 2012). This will bridge the research-implementation gap and is relevant to this thesis, where the proposed approach is informed by research, but designed for practical application to the health system.

In summary, this section summarised how performance on the CoC has been measured. Although not extensive, it showed the multifaceted nature of performance measurement on the

CoC, which includes outcome-oriented measures, coverage and quality of care, and factors that influence utilization. Additionally, the literature highlights the importance of exploring providers' and users' perspectives and experiences of the continuum. There are still gaps in comprehensive measurement of the CoC performance and the research in this thesis is intended to contribute to knowledge in that area.

2.3 Informative quality of care and health service frameworks

There are other frameworks for comprehensive service delivery that share characteristics with the CoC framework, from which lessons in performance measurement can be learned. For example, the five pronged model for prevention of maternal and neonatal morbidity and mortality contains social determinants of health and community care elements as reflected in the CoC framework (Mwaniki et al., 2016). In prong 1, the model outlines preventive interventions including family planning, education, and economic empowerment of women (see Figure 1). Prong 2 of secondary prevention focuses on care seeking factors, including danger sign recognition, behaviour change and demand for care. Other prongs are related to barriers to access such as transport and poor referral systems (Prong 3), quality of care (Prong 4), and follow-ups to prevent complications (prong 5). These factors have also been identified in terms of service delivery gaps and health system strengthening needs for improving maternal health outcomes in South Africa (NCCEMD, 2014; NCCEMD & Department of Health, 2016; Department of Health, 2017d; Pillay & Barron, 2018; Schneider et al., 2018b).

The five-prong framework helps deepen understanding of the family/community level factors in maternal health in terms of care seeking and care provision. But unlike the CoC, the five-prong framework also includes system wide factors such as financing, human resources and research that capture the system wide perspective of elements that influence maternal and

neonatal health outcomes (Mwaniki et al., 2016). In contrast, the CoC framework focuses on service delivery main element of the health system building blocks. Nonetheless, the five-prong framework remains complementary to the preventive, service delivery related aspects of the CoC framework. The analytical framework for success factors in women and children's health posits and that service delivery, alongside other building blocks, can be an independent variable in maternal and child health outcomes (Kuruvilla et al., 2014). The Kuruvilla analytical framework (2014) thus emphasizes the importance of service delivery as a component of maternal health determinants.

Existing quality frameworks can inform the integration of quality of care measures on the CoC framework. An example is the South African Department of Health framework for improvement of quality in service delivery (Department of Health, 2012c). The quality improvement framework complements standards for care guidelines used by healthcare workers and informs monitoring and evaluation in the country. The South African approach to quality improvement emphasizes a system-wide perspective, using the WHO building blocks of a health system (Department of Health, 2012c). A strong system produces better quality of care, beyond the quality improvement of specific programs. This principle informs the approach in the study of the CoC in this thesis, to use system-wide measures of readiness to provide quality of care, beyond just the focus on quality of care within interventions.

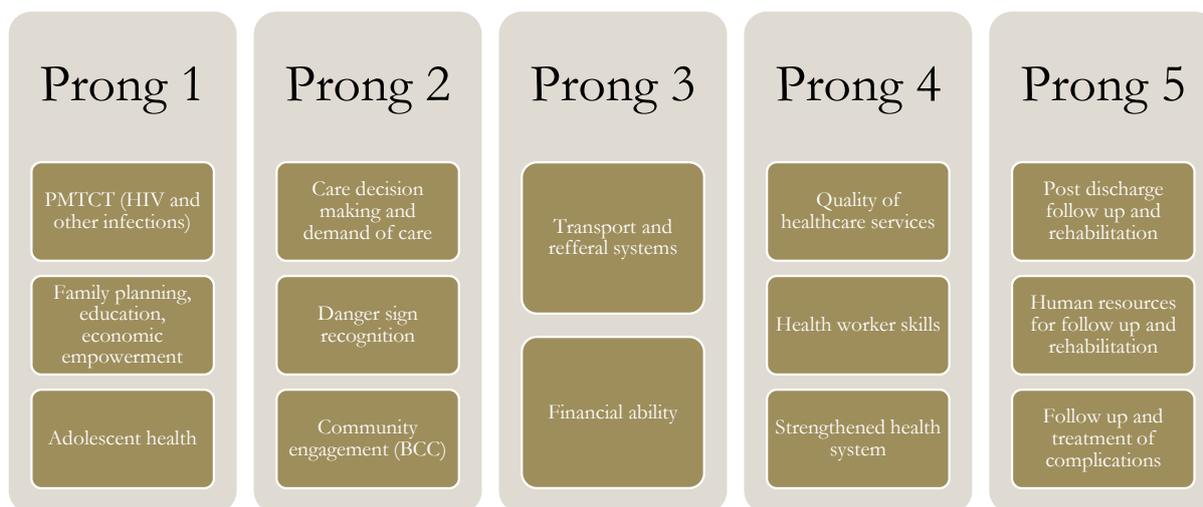


Figure 1: Five prong framework for understanding and preventing maternal-neonatal morbidity and mortality in low- income countries, adapted from Mwaniki et al. (2016) for maternal health relevant aspects.

One of the system wide strengthening frameworks to improve quality of care at the primary level in South Africa is the Ideal Clinic Realization and Maintenance Program (ICRMP) (Department of Health, 2017c; Department of Health, 2017; Hunter et al., 2017). The ICRMP consists of facility assessments of quality of care from a multidimensional perspective. In order to achieve facility-wide Ideal Clinic status, a facility needs to strengthen different aspects of service delivery, not just clinical care. This includes outreach to communities through ward-based outreach teams (Schneider et al., 2018) and intersectoral or multisectoral collaborations to address social determinants of health. Intersectoral and multisectoral collaboration is a policy direction seen as holding promise for improvement of maternal and related health outcomes in LMICs (Rasanathan et al., 2015, 2017; Valentine & Bonsel, 2016). This program is similar to the National Core Standards which guide readiness to provide multidimensional quality of care at the hospital level (Department of Health, 2011b). These frameworks inform the system-wide measurement of quality of care and can thus inform quality integration for the CoC.

Lastly, the framework for health service evaluation and monitoring developed and tested in Australia (Reeve et al., 2015) is informative for integration of community services on the CoC.

The framework measures health service performance in terms of structural, process and outcome indicators – or the Donabedian (1988) approach. In the Reeve et al. (2015) framework, the comprehensiveness of service delivery is considered along-side quality of care, structural determinants of health and sustainability factors. This framework is multifaceted and includes the community level of care. The focus on inputs, processes and outputs also means that specific service-related recommendations can be made, versus a pure focus on impact indicators. The interventions in the CoC framework also constitute inputs, processes, outputs and outcomes of the health system and other sectors, which all can be used to measure and monitor performance.

This section demonstrated the synergies of ideas between existing service and quality of care frameworks and the CoC. These frameworks provide insight into the understanding, measurement and monitoring of services along the continuum, including under defined aspects such as quality of care.

2.4 Analytical framework and monitoring & evaluation

The measurement, assessment and monitoring approach for the CoC can be presented as an analytical framework, useful for research and practice. Analytical frameworks are used to understand, explain and support operationalization of areas of study in public health and health systems (Bautista-Arredondo et al., 2008; Calciolari & Ilinca, 2011; Musgrove et al., 2000). They are knowledge structuring tools that provide a more unified approach when a concept has multiple and varied layers of application in practice (Calciolari & Ilinca, 2011; Kabeer, 2009). This is also applicable to the CoC framework, as there is currently no standard way to measure and monitor performance in health systems and public health practice. A uniform analytical approach could help enhance understanding of the CoC and its role in maternal health service

delivery and ultimately, outcome improvement. In public health practice, analytical framework can support planning, implementation and resource allocation for interventions (Bautista-Arredondo et al., 2008; Birch et al., 2007; Blas et al., 2010; Calciolari & Ilinca, 2011; Fujita et al., 2012; Jacobs et al., 2012). Thus, an analytical framework for the CoC can also be used to support planning and implementation of comprehensive service delivery for maternal health.

Analytical frameworks include measurement tools or indicators that support monitoring and evaluation (M&E) of health system and public health efforts. Part of addressing multiple challenges in public health is ensuring sufficient monitoring of the determinants of health outcomes. Continuous improvement to M&E systems lead to better program design and planning (Valentine et al., 2016). New measurement tools can improve the effectiveness and targeting of interventions, ensuring better impact without additional resources (Shengelia et al., 2005). In South Africa, there are gaps in the M&E system for maternal, newborn, child, and women's health and nutrition (MNCWH&N), including indicators, data quality and reporting (Department of Health, 2012d). Many of the indicators prioritized in the current M&E framework are outcome oriented, except for antenatal and skilled birth attendance. Performance indicators for ending maternal mortality need to be not only outcome oriented, but include the inputs of the system as well (Moran et al., 2016). As stated earlier, the indicators of interest in this thesis encompass input, process, output, and outcomes to fill current gaps in M&E.

The assessment of the CoC from a comprehensive perspective needs innovative approaches for handling data from multiple sources. Munos et al. (2017) explored the integration of household surveys and health facility assessments to measure intervention coverage across 58 CoC interventions. They found complementarities between household survey data and facility-based assessments in LMICs, which could be integrated to create population-based intervention

coverage data for the continuum interventions (Munos et al., 2017). The Munos et al. (2017) study does not rely on routine health information data due to challenges in reporting and quality of data in LMICs. South Africa does not routinely carry out the provider assessment surveys that the study relied on, such as the DHS program's Service Provision Assessment and WHO's Service Availability and Readiness Assessment (Munos et al., 2017). The country mainly relies on the health information system. In a Kenyan study, Maina et al. (2017) used routine information system and population data to make coverage estimates for maternal and child health interventions. These studies demonstrate that secondary data analysis can provide additional insights and formulate new indicators for maternal health, which is useful in time and resource constrained research. The research in this thesis explores the methodology for integrating health system and population-based data to formulate monitoring indicators for the CoC for maternal health.

This section briefly discussed the utility of developing an analytical framework as a standard approach for measurement and monitoring of the CoC for maternal health in South Africa and other LMICs. The components of the analytical frameworks include indicators that could be used in M&E of maternal health interventions. An important consideration is the way in which, health system and non-health system (population based) data, can be integrated and effectively used to monitor performance on the CoC.

Summary of the literature review

This chapter provided an overview of the relevance of the CoC to maternal health outcomes. In addition, the review highlighted some literature on measurement of performance on the CoC, although a more detailed approach will be presented in Chapter 3. Performance on the CoC can be measured in terms of coverage, effective coverage, quality of care, and effectiveness of interventions, among other measures. An important gap identified by the literature is the lack

of comprehensiveness of current measurement and monitoring approaches. Chapter 3 will provide a more systematic approach to understanding the gaps and is a basis for measurement and monitoring recommendations that inform the rest of the thesis. In this chapter, the synergies and contrasts between the CoC and other quality and health service frameworks were also explored. These include health prevention frameworks that highlight the importance of the community level of care and system wide quality of care. Lastly, the need to create a uniform analytical framework was described.



Chapter 3 – Systematic review and development of the adequacy construct

Chapter 3 was published as a peer reviewed research article titled “Measurement approaches in continuum of care for maternal health: a critical interpretive synthesis of evidence from LMICs and its implications for the South African context” Authors: Mamothena Mothupi, Lucia Knight, Hanani Tabana. 2018 *BMC Health Services Research*/ 18(539) / <https://doi.org/10.1186/s12913-018-3278-4>. There were a few formatting changes from the original manuscript, related to placement of figures and tables.

This chapter presents the systematic review of literature on the measurement approaches for the CoC for maternal health. The brief literature review in Chapter 2 showed a variety of approaches for measurement of performance on the CoC in LMICs. Thus, the author was interested in gaining more insight on these measurement approaches, in order to synthesize evidence and develop an approach that could be used for the rest of the research in this thesis. Research studies on measurement and monitoring of the CoC have different advantages and limitations and thus the evidence synthesis approach used in this chapter aimed to learn from these and propose a more comprehensive approach.

An important contribution of the evidence synthesis in this chapter is that it presented measurement of the CoC through a singular construct, called the adequacy construct. The adequacy approach can be linked to the theoretical framework introduced in Chapter 1, where the CoC is regarded as an emergent outcome of a complex system. In addition, according to the critical realist methodology adopted in this research (Chapter 1), the CoC can be measured in terms of the available empirical data as well as exploration of potential underlying structure. Thus, the adequacy construct achieved two goals – it is a conceptual model for measurement of the CoC as well as a guide to the types of indicators needed to monitor it comprehensively. It is applicable to measurement of the CoC in South Africa and other LMICs, as it is based on original studies from these areas.

Measurement approaches in continuum of care for maternal health: a critical interpretive synthesis of evidence from LMICs and its implications for the South African context

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Abstract

Background: Global strategies recommend a continuum of care for maternal health to improve outcomes and access to care in low- and middle-income countries (LMICs). South Africa has already set priority interventions along the continuum of care for maternal health and mandated their implementation at the district health level. However, the approach for monitoring access to this continuum of care has not yet been defined. This review assessed measurement approaches in continuum of care for maternal health among LMICs and their implications for the South African context.

Methods: We conducted a critical interpretive synthesis of quantitative and qualitative research sourced from Academic Search Complete (EBSCO), MEDLINE (Pubmed), Cambridge Journals Online, Credo Reference and Science Direct. We selected 20 out of 118 articles into the analysis, following a rigorous quality appraisal and relevance assessment. The outcomes of the synthesis were new constructs for the measurement of continuum of care for maternal health, derived from the existing knowledge gaps.

Results: We learned that coverage was the main approach for measuring and monitoring the continuum of care for maternal health in LMICs. The measure of *effective coverage* was also used to integrate quality into coverage of care. Like coverage, there was no uniform definition of effective coverage, and we observed gaps in the measurement of multiple dimensions of quality. From the evidence, we derived a new construct called *adequacy* that incorporated timeliness of care, coverage, and the complex nature of quality. We described the implications of adequacy to the measurement of the continuum of care for maternal health in South Africa.

Conclusions: Critical interpretive synthesis allowed new understandings of measurement of the continuum of care for maternal health in South Africa. The new construct of *adequacy* can

be the basis of a new measure of access to the continuum of care for maternal health. Although adequacy conceptualizes a more holistic approach, more research is needed to derive its indicators and metrics using South African data sources.

Keywords: Continuum of care; maternal health; critical interpretive synthesis; maternal health services; low- and middle-income countries; South Africa



Background

One of the health and well-being targets of the Sustainable Development Goals is to reduce the global maternal mortality ratio to less than 70 deaths per 100,000 live births (UN-DESA, 2017). Health service delivery strategies such as the continuum of care are touted as important components of strong health systems, needed to prevent and reduce maternal morbidity and mortality (Bamford, 2012; Kerber et al., 2007; PMNCH, 2010). The continuum of care ensures that services are provided in an integrated manner to reduce duplication of effort and save costs (Kerber et al., 2007). It is defined as,

“...access to care provided by families and communities, by outpatient and outreach services, and by clinical services throughout the lifecycle, including adolescence, pregnancy, childbirth, the postnatal period, and childhood. Saving lives depends on high coverage and quality of integrated service-delivery packages throughout the continuum, with functional linkages between levels of care in the health system and between service-delivery packages, so that the care provided at each time and place contributes to the effectiveness of all the linked packages.” [Kerber et al. (2007), p1359]

The continuum of care framework for maternal and child health in low- and middle-income countries is illustrated in Figure 1. This framework illustrates the health service interventions to be provided throughout the lifecycle, as well as the social dimensions of care.

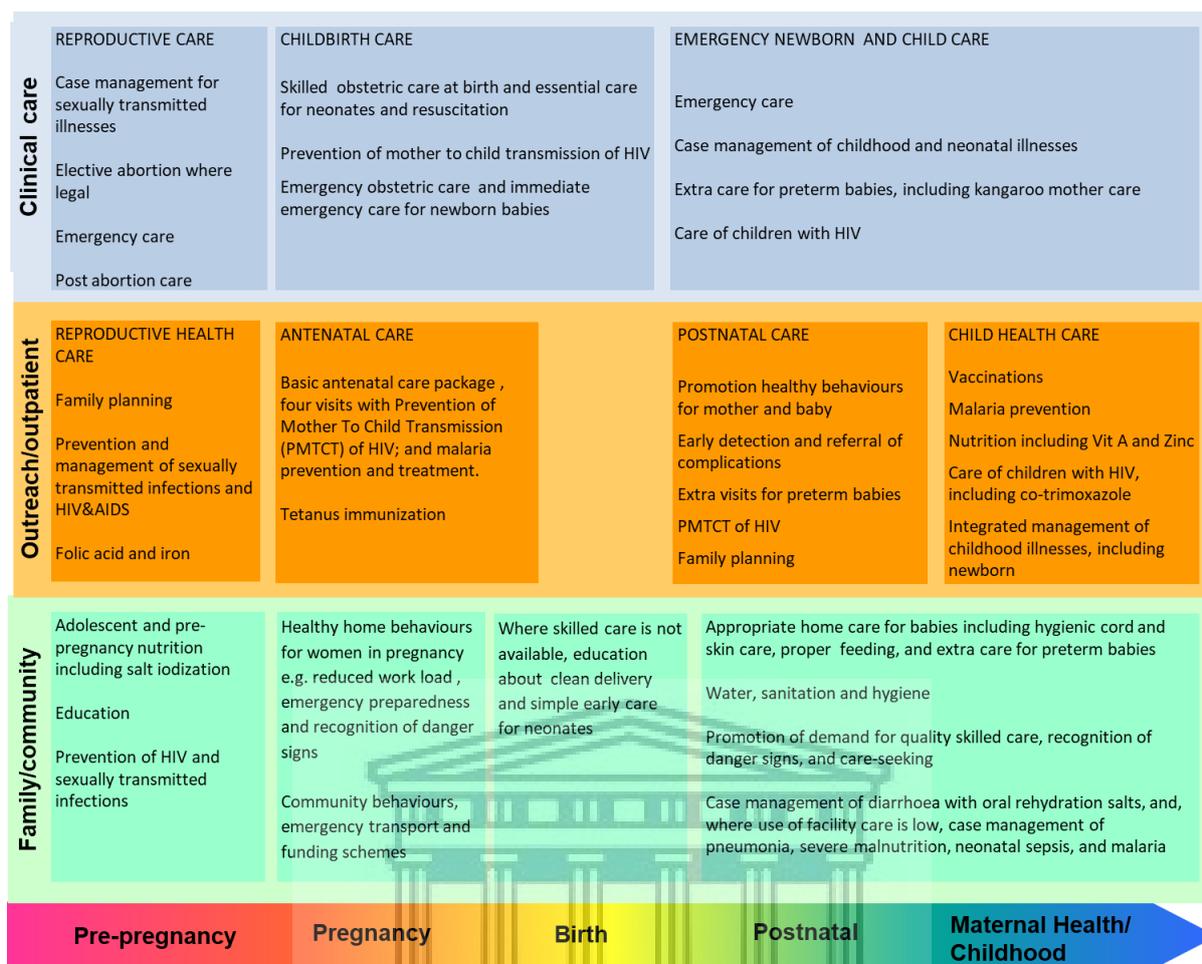


Figure 1: Continuum of care for maternal and child health in low and middle income countries (Adapted from (Kerber et al., 2007)).

In South Africa, the continuum of care is expected to lower the maternal mortality ratio from the current estimated 140 deaths per 100,000 live births in 2013, to less than 100 deaths per 100,000 live births by 2019 (Department of Health, 2014). The Department of Health in South Africa has outlined its own maternal (and child health) continuum of care framework which is similar to the Kerber framework (Figure 2) (Bradshaw et al., 2008). The framework adds care at the specialist/regional hospital levels and isolates social determinants of health as “intersectoral factors”. In addition, the National Strategic Plan for Maternal, New-born, Child and Women’s Health and Nutrition 2012-2016 of the department has set out priority interventions for up to six days post-delivery (Department of Health, 2012e). However, there

were still gaps in defining pre-pregnancy, post-natal and community support interventions in the strategic plan, despite the existing frameworks elsewhere (Chola et al., 2015; Chopra, Lawn, et al., 2009).

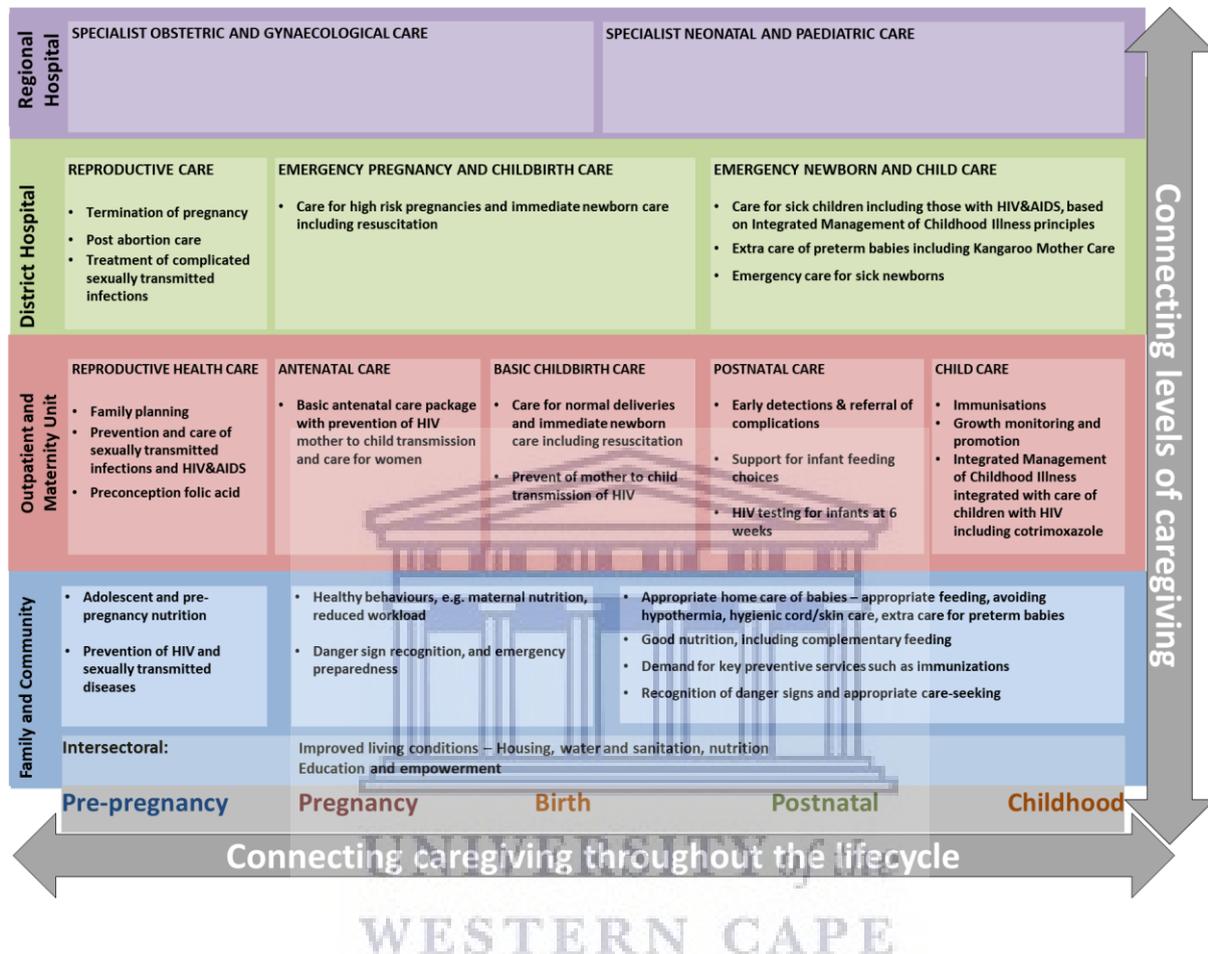


Figure 2: The continuum of care for maternal and child health framework as adapted to the South African health system (Bradshaw et al., 2008)

An effective continuum of care is expected to have a positive impact on maternal (and child) health outcomes (Bamford, 2012; Chopra, Daviaud, et al., 2009; Kerber et al., 2007). It is important, therefore, to use the established frameworks to measure and monitor progress in improving women's access to the continuum care. Progress in implementing a continuum of care can be measured and monitored at the district level, as this is the “heart” of efforts to improve maternal and new-born services in South Africa and other LMICs (Department of Health, 2012b; WHO, 2005). The district encompasses the family/community, outpatient

primary centres and maternity units, and the district hospital on the continuum of care for maternal health (Figure 2). It is the focus of primary health care re-engineering efforts in South Africa, which aim to increase access to good quality care at the district level (Bamford, 2012; Chopra, Daviaud, et al., 2009; Kautzky & Tollman, 2008). However, there is no defined measurement approach to assess how well districts are performing in providing an effective continuum of care.

Researchers and policymakers use a variety of ways to measure and monitor access to the continuum of care for maternal and child health. These are in the form of various indicators that allow public health decision makers to track performance over time and across geographical areas. There is a lack of research for continuum of care measurement approaches in the South African context. This study was a systematic review of literature to explore the maternal continuum of care measurement strategies in public health research and practice among LMICs. The aim was to characterize how maternal continuum of care access was conceptualized and measured; and to describe the implications for a measurement approach in the South African health system. This measurement approach will guide and contribute to monitoring efforts and future research related to the performance of the district health system and evaluation of maternal health outcomes.

Methods

Study Design. We conducted a critical interpretive synthesis to systematically select studies, synthesize the findings and critically assess the evidence (Dixon-Woods et al., 2006). Critical interpretive synthesis (CIS) is a review of both qualitative and quantitative studies, and the outcome is a qualitative synthesis of the evidence. The main outcomes of a critical interpretive synthesis are new *constructs* based on the evidence and used to further the understanding of

phenomena under study. CIS also uses an iterative, dynamic process to refine the review question and further develop the emerging constructs. We thus used a systematic process to first review the evidence and formulate constructs, and an additional literature review to explore their meaning and application in a specific context. The study selection, review and evidence synthesis were conducted in the period November 2016 – June 2017.

Sampling and Study Selection. We conducted a search of peer reviewed articles, published or translated to English, on Academic Search Complete (EBSCO), MEDLINE (Pubmed), Cambridge Journals Online, Credo Reference and Science Direct. The initial review question was: *What indicators, methods, conceptual models and theories are used in the measurement of maternal health service delivery (including quality) and continuum of care in LMICs including South Africa?* The following key words were used as prompts: *continuum of care measurement, continuum of care model, continuum of care index, composite health measure, health service access measurement, adequacy of care measure, quality of health care measures, maternal health care quality, maternal health care coverage, maternal health care measure, care coverage measure, coverage of care models, and quality of care models.* Additional studies were also searched from the bibliographies of the studies selected by the key words (Gough et al., 2012). We searched more literature during the analysis phase to validate the emerging constructs.

The process of systematic selection of literature is presented in Figure 3. There were 556 articles selected after a search and review of titles and abstracts from the literature databases. We then assessed these articles according to the inclusion and exclusion criteria outlined in Table 1.

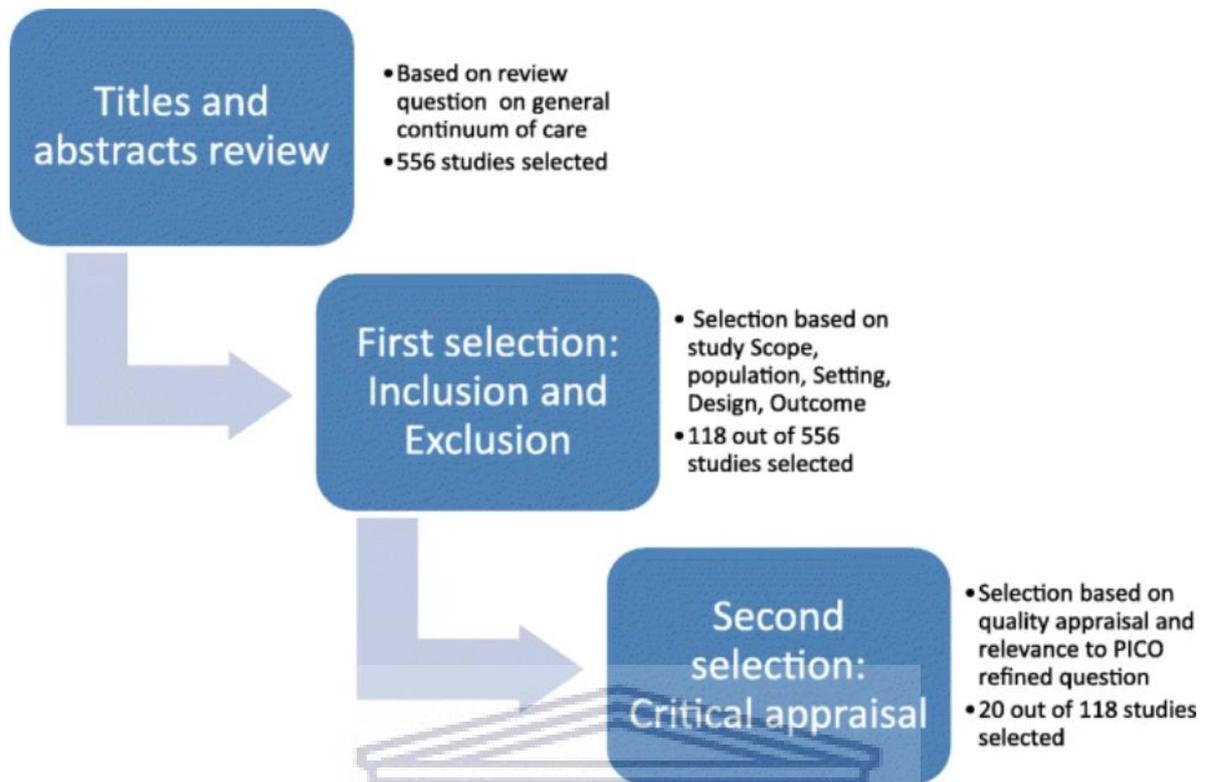


Figure 3: The process of selecting literature into the review

We retained 118 articles after applying the inclusion and exclusion criteria. We then conducted a second relevance appraisal using a refined review question, more specific to continuum of care measurement and excluding other measures of health service delivery. This kind of iteration is characteristic of critical interpretive synthesis (Dixon-Woods et al., 2006). We used PICO (Population, Intervention, Comparator and Outcome) guidelines to re-define the review question (Schünemann et al., 2013): “*How is the continuum of care (including quality thereof) to improve maternal health measured, for women of child-bearing age, in LMICs?*” Using the PICO guided question, a total of 20 studies were selected for quality appraisal and data extraction.

Table 1: Main inclusion and exclusion criteria for studies selected in the review

Main Criteria	Specific Criteria
Inclusion:	
<i>Scope</i>	Focus on: i) maternal continuum of care, or ii) adequacy of maternal healthcare service, or iii) the incorporation of quality into maternal continuum of care implementation or measurement, or iv) quality of care for maternal health within a continuum of care context
<i>Population</i>	Studies are focused on women of reproductive age Studies can also include perinatal population (maternal and neonatal health if they are relevant in scope)
<i>Setting</i>	Observational studies: Low- and middle-income countries Theoretical studies: relevance to scope Setting may include community care if discussed in terms of continuum of care or integration into the health system Studies may be based in health systems, both health system and community care context, community care or population care (where relevant in scope)
<i>Outcome Variables</i>	The study is focused on continuum of care in maternal health, and other conceptual and theoretical approaches in reproductive health and maternal, neonatal, and child health is relevant. Non-maternal health indicators and models of continuum of care are outside the scope of this study
<i>Time Period</i>	No publication date limit
<i>Language</i>	Articles originally written in English, or an English translation from the original language if available
Exclusion:	
<i>Study design</i>	Opinion pieces/commentaries/letters to editors within inclusion scope
<i>Scope</i>	General maternal health service access and utilization literature outside of inclusion scope

*Based on (Meline, 2006)

Quality Appraisal. We appraised the 20 selected studies in terms of methodological rigour, using a checklist that was based on both qualitative and quantitative research guidelines (Lewin et al., 2015; Spencer et al., 2003; The Cochrane Collaboration, 2017; Walsh et al., 2006). The

studies were assessed on general areas of findings, design and sampling, analysis, reporting and interpretation, and ethics. In addition, we assessed qualitative studies on reflexivity and neutrality, and quantitative studies on risk of bias (Appendix 1). Qualitative and quantitative studies were scored out of 12 points each, and mixed methods studies out of 13. The 20 studies assessed scored between 7-11 out of 12 for traditional designs, and 10-11 out of 13 for the mixed methods: Scoring over 50%, all studies were thus included in the data analysis and synthesis.

Data Extraction and Synthesis. There were 4 qualitative, 4 mixed methods and 12 quantitative studies included in the review. We extracted data onto a form that summarized the methods and design, key themes/indicators/models related to continuum of care measurement, interpretations and recommendations by authors, and our interpretations as investigators (Munro et al., 2007; Noyes & Lewin, 2010). This form is attached as Appendix 2. The forms were then uploaded to ATLAS.ti 8.0, a qualitative analysis software, for data coding and synthesis (ATLAS.ti, 2016). The critical interpretive synthesis relies on techniques similar to meta-ethnography in qualitative studies, in this case applied to mixed method evidence (Dixon-Woods et al., 2006). The evidence from the 20 articles is aggregated in Appendix 3 and includes methodology, metrics and indicators, and general findings. We focus our findings on the interpretation of this evidence and describe the main constructs of coverage, effective coverage and quality. We then formulated a new, synthetic construct of *adequacy of maternal continuum of care* as a result of evidence synthesis and critical reflection. *Synthetic constructs* provide the higher level explanation or clarity of a phenomenon that doesn't currently exist in the evidence (Dixon-Woods et al., 2006). We used the synthetic and other constructs to make an argument about the evidence implications to the South African context.

Results

The basis of our synthesis is the evidence summarized in Appendix 3, and it informs our interpretations of the metrics and methods used to measure the continuum of care for maternal health. Since the continuum of care framework was developed (Kerber et al., 2007), researchers have described country specific frameworks and defined indicators for coverage and quality. The number of coverage indicators differs across studies, but consistently includes the “triad” - antenatal care visits, skilled birth attendance and post-natal care check-ups (Abegunde, Orobato, Sadauki, et al., 2015; Abegunde, Orobato, Shore, et al., 2015; Akinyemi et al., 2016; Marchant et al., 2015; Owili et al., 2016; Singh et al., 2016; Wang & Hong, 2015; Yeji et al., 2015). Other indicators are related to reproductive health, newborn and child health, as well as the intersectoral factors/social determinants of health along the continuum (Abegunde, Orobato, Sadauki, et al., 2015; Abegunde, Orobato, Shore, et al., 2015; Ashish et al., 2011; Owili et al., 2016; Rai et al., 2012; Roberts et al., 2015; Singh et al., 2016). Researchers have also developed varied indicators and indices to monitor quality of care along the continuum (Dettrick et al., 2016; Lavender, 2016; Marchant et al., 2015; Nesbitt et al., 2013; Wilunda et al., 2015). These indicators focus mainly on content of care or performance of signal functions across continuum interventions. Lavender et al (2016) provides a general review of quality frameworks and suggests that other aspects of quality are also important; these include women’s experiences of care and organizational factors such as staffing and resources(Lavender, 2016). The non-medical indicators of quality along the continuum were explored in only 2 studies in our review (Nesbitt et al., 2013; Wilunda et al., 2015). Studies relied on different data sources to measure coverage and quality along the continuum, including Demographic and Health Surveys, routine health information systems and other household and facility data (Appendix 3). Many studies in this review used

mathematical and statistical modelling methods to develop metrics related to the continuum of care, estimate trends and assess relationships (Akinyemi et al., 2016; Dettrick et al., 2016; Nesbitt et al., 2013; Owili et al., 2016; Rai et al., 2012; Wehrmeister et al., 2016).

Composite coverage metrics

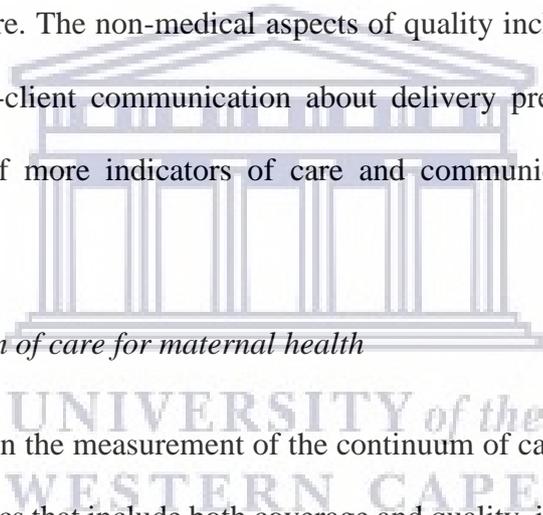
Composite coverage metrics are used to monitor women's access to available maternal health services on the continuum (Rai et al., 2012; Wehrmeister et al., 2016). Coverage estimates are often measured per intervention, while composite metrics reflect a combination of indicators across different continuum packages. The composite coverage metrics found in this review include the Composite Coverage Index (Wehrmeister et al., 2016), Co-Coverage Index (Wehrmeister et al., 2016), and the Coverage Gap Index (Rai et al., 2012). Each index consists of a set of indicators representing interventions along the continuum. While possessing different sets of indicators, the indices are nonetheless applied to similar monitoring goals for public health research and practice. For example, Wehrmeister et al (2016) found the Co-Coverage Index and the Composite Coverage Index to be correlated with each other and used to monitor Reproductive, Maternal, Neonatal and Child Health in similar health care settings (Wehrmeister et al., 2016). Although they include some maternal health indicators, both of these indices were associated only with neonatal and child health outcomes (Wehrmeister et al., 2016). The Coverage Gap Index also included many indicators of child health related to immunizations and treatment of childhood illnesses (Rai et al., 2012).

Composite quality metrics

In order to measure quality of care along the continuum, researchers sometimes used *effective coverage* as a metric (Flenady et al., 2016; Marchant et al., 2015; Nesbitt et al., 2013). Effective coverage measures the coverage of interventions delivered with high quality. It is similar to the

idea of “quality contacts”, which are often lower in coverage than overall contact/ visitations (Marchant et al., 2015). Effective coverage can be assessed with not just performance of signal medical functions but can include “non-medical” aspects of quality as well (Nesbitt et al., 2013). Effective coverage can be measured for each stage of the maternal lifecycle (Marchant et al., 2015) or for whole facilities (Nesbitt et al., 2013). The concept is thus applied differently by researchers, using different indicators in different study settings.

The Quality Index is similar to effective coverage measurement in that it is concerned with indicators of content of care, all aggregated into a single metric (Dettrick et al., 2016). The index was developed using demographic and health survey indicators across antenatal, perinatal and post-natal care. The non-medical aspects of quality included in the metric were related to health provider-client communication about delivery preparedness. The authors recommended inclusion of more indicators of care and communication across the wider continuum of care.



The adequacy of continuum of care for maternal health

Our review revealed gaps in the measurement of the continuum of care for maternal health in terms of i) composite metrics that include both coverage and quality, ii) composite metrics that include more maternal health components, and iii) multi-dimensional quality measurement. In order to address these gaps, we used the evidence in the review to explore a more holistic measure of the continuum of care for maternal health, termed *adequacy*. Adequacy will address more maternal health indicators, the integration of quality measures, and the intersectoral factors across the continuum.

As an iterative process, CIS allowed us more qualitative review of literature to explore the meaning of the emerging construct of adequacy (Barnett-Page & Thomas, 2009; Dixon-Woods

et al., 2006). Adequacy has been applied to evaluation of antenatal care programs (Heredia-pi et al., 2016; Hodgins & D'Agostino, 2014; Kotelchuck, 1994; Villar et al., 2001); assessment of human and health system resources (Department of Health, 2014; Srivastava et al., 2015) and overall performance (Ross et al., 2001); assessment of dimensions of care (WHO, 2005b); and evaluation of impact of interventions (Burchett & Mayhew, 2009; Habicht et al., 1999). Adequacy is often expressed as a count or combination of interventions that produce positive effects on maternal health and related outcomes. From our continuum of care perspective therefore, adequacy would reflect the *collective* threshold of interventions needed to produce positive maternal health outcomes. This collective can be measured via metrics that comprise indicators across packages of care and calculated by statistical methods.

Other authors have measured adequacy within a single package of care and investigated how it affects utilization of services along the continuum (Owili et al., 2016). In that study, adequacy was a latent construct consisting of indicators of effective coverage similar to those discussed earlier. Our concept of adequate continuum of care for maternal health focuses on the collective performance of indicators across packages of care. The Kerber framework and its adaptations are useful for guiding the types of interventions to be provided along the continuum of care for maternal health (Bradshaw et al., 2008; Kerber et al., 2007); whereas an adequacy framework can help lay out a measurement approach for monitoring integrated service provision at district levels. Although indicators of adequacy will depend on a thorough assessment of data sources at district levels, the evidence in this review can provide us with a tentative definition of the approach as:

Measurement of timely access to evidence based interventions encompassed by the continuum of care service provision framework for maternal and child health, through a positive experience of care and within a supportive structural context that ensures

good quality of care (i.e. competent human resources, actionable information systems, functional referral systems and essential physical resources).

Adequacy is thus a patient-centred measure, even though in practice many of the indicators are measured from the supply side.

Discussion

This critical interpretive synthesis revealed that *coverage*, *effective coverage* and *quality* were the main measurements made on the continuum of care for maternal health. Coverage is a measure of access to healthcare among those who need it, as opposed to mere availability of services (Bryce et al., 2013; Kerber et al., 2007). It can be calculated for specific interventions or packages along the continuum of care (Abegunde, Orobato, Shore, et al., 2015; Roberts et al., 2015; Singh et al., 2016; Wang & Hong, 2015). Composite metrics or indices of coverage cover a combination of interventions across packages (Rai et al., 2012; Wehrmeister et al., 2016). The composite indices found in this study were reflective of newborn and child health outcomes, while overall indicators varied across studies. This makes them unsuitable for measurement of coverage along the continuum of care for maternal health.

The studies in this review measured quality through a detailed assessment of sets of often numerous indicators (Flenady et al., 2016; Wilunda et al., 2015), or through composite metrics such as effective coverage and the Quality Index (Dettrick et al., 2016; Nesbitt et al., 2013). These quality metrics focused on content of care and, to a lesser extent, its “context”. Context of quality of care is defined by organizational factors and patient experience of care (Lavender, 2016). There are frameworks such as the WHO Quality of Care Framework for Maternal and Newborn Health (Lavender, 2016; Tunçalp et al., 2015) which capture these factors in terms of physical and human resources, referral and information systems, and physical infrastructure.

Our definition of an adequate continuum of care for maternal health incorporates the measurement of coverage and the multidimensional quality of care to influence health outcomes.

Besides coverage and quality, an integrated measure of continuum of care adequacy will include the social determinants of health largely missing from existing measures. The concept of timeliness is also crucial to the definition of adequacy of care delivered (Heredia-pi et al., 2016; Owili et al., 2016). The adequacy of continuum of care for maternal health can be measured at the health district level in South Africa, as it encompasses all of the framework interventions needed to improve maternal health outcomes (Bamford, 2012; Bradshaw et al., 2008; Chopra, Lawn, et al., 2009; Department of Health, 2012b; Kautzky & Tollman, 2008). Horizontal metrics of adequacy at each level of care can help measure performance at that level and support localized decision making. Diagonal metrics that include all levels from family/community to the district level can reflect overall health district performance. These applications of adequacy would be consistent with how current metrics are measured and applied and will shed more light on maternal health at subnational level.

Studies in this review depended on various data sources to identify or derive indicators for coverage and/or quality along the maternal continuum of care. These data sources included household surveys, community health surveillance, and routine health information system data. In the South African context, adequacy can be measured through triangulation of all these different data sources. Data source interpolation has been recommended as one strategy to improve data sufficiency: for instance, data from population surveys can be supplemented with routine health information system to provide more accurate estimations of coverage and include a wider range of indicators (Bryce et al., 2013; Marchant et al., 2015). Examples of these data sources in South Africa are the District Health Information System (Burger et al.,

2016; Herbst et al., 2002); Demographic and Health Survey and intersectoral factor data from the national statistics body, Statistics South Africa (Statistics South Africa, 2017c). Health and socio-demographic surveillance systems such as Agincourt Health and Demographic Surveillance System are also vital sources of data on the life course, which help evaluate coverage and impact of both health and social interventions (Kahn et al., 2012). These are theoretical applications however, as a detailed assessment of South African health information systems is needed to derive indicators and model the adequacy metrics. The focus of the review was the conceptual backgrounds, indicators and metrics used to measure the continuum of care, and thus we do not delve into broader aspects of monitoring related to policy and implementation.

Conclusion

Current measurement approaches for the maternal health continuum of care are neither integrated enough nor immediately applicable to the South African context. Their applicability is limited by variability among the metrics, lack of comprehensiveness and the association with child rather than maternal health outcomes among others. Critical interpretive synthesis helped us synthesize the evidence on these approaches and propose a useful way forward. We conceptualized adequacy as an integrated measure of quality, coverage and the social determinants of health/intersectoral factors. This integrated approach will address some of the challenges observed in the current measures and is focused on maternal health. We discussed the potential configuration of adequacy metrics based on the findings of the synthesis. However, more research is needed to derive indicators from the proposed data sources and formulate metrics using the appropriate methods.

Declarations

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Availability of data and material

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

The author(s) declare(s) that they have no competing interests.

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Authors' contributions

MCM contributed to study conception and design, data collection, analysis and interpretation of data. She drafted and revised the manuscript and approved the final version. LK contributed



to study conception and design, data collection and validation, interpretation of data, critical input and revision of manuscript, and approval of final version. HT contributed to interpretation of data, critical input and revision of manuscript, and approved the final version.

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References

(please see [References](#) section at the end of the thesis)

Tables and Figures

(in text)

Supplementary Files

1. [Appendix 1 Quality Assessment Criteria](#)

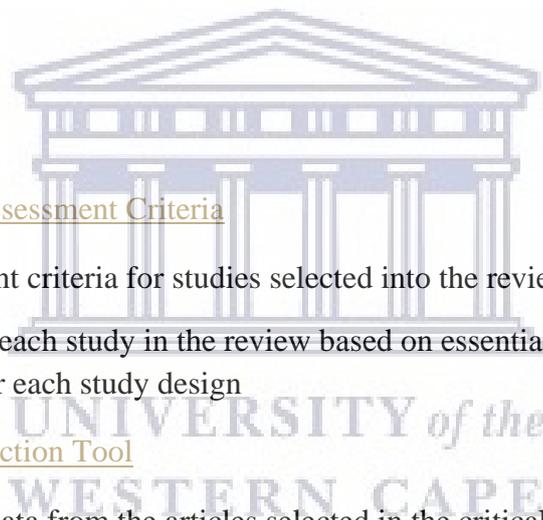
- The quality assessment criteria for studies selected into the review
- The scoring guide for each study in the review based on essential criteria and key indicators/questions for each study design

2. [Appendix 2 Data Extraction Tool](#)

- Tool used to extract data from the articles selected in the critical interpretive synthesis
- Includes aims of the study, theoretical framework, data analysis approach, key indicators, and main findings, among others.

3. [Appendix 3 Summary of Findings](#)

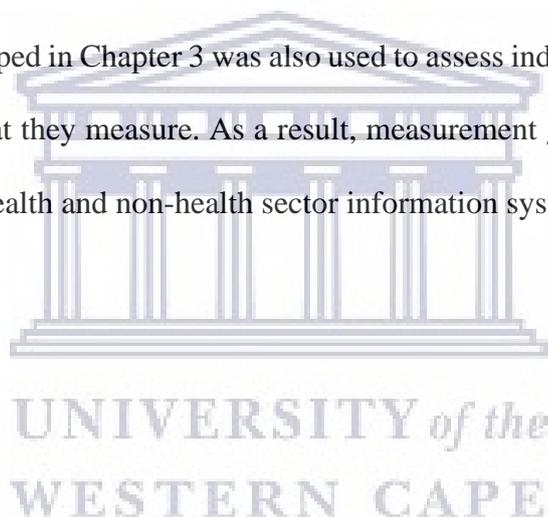
- Summary of main findings, methodology and metrics/indicators identified among all the articles reviewed
- Summary for the 20 articles selected into the review



Chapter 4 – Indicators for continuum of care measurement and monitoring

Chapter 4 was published as a peer-reviewed research note titled “Review of health and non-health sector indicators for monitoring service provision along the continuum of care for maternal health” Author(s): Mamothena Mothupi, Lucia Knight, Hanani Tabana 2020 *BMC Research Notes*/ 13(151)/ <https://doi.org/10.1186/s13104-020-04984-9>

This chapter focused on the process for the review and selection of indicators for the CoC for maternal health in South Africa. The chapter described the information sources used and assessed the indicators available across interventions on the continuum. The result of the study is an indicator set applicable to monitoring the CoC for maternal health in the South African context. Gaps in measurement were identified based on review of relevant literature. The adequacy construct developed in Chapter 3 was also used to assess indicators by examining the dimensions of the CoC that they measure. As a result, measurement gaps were identified that could be filled by future health and non-health sector information system strengthening.



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

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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.

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.

Introduction

The continuum of care is a strategy for improving the efficiency and effectiveness of service delivery for maternal health (Bradshaw et al., 2008; Kerber et al., 2007). 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 (Department of Health, 2012e, 2015). 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.

Figure 1. Continuum of care framework for maternal and newborn health in South Africa

(Source: Bradshaw et al, 2008).

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 (Mothupi, 2018). 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.

Main text

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 (Department of Health, 2011a). 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 (Department of Health, 2019). 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 (Department of Planning Monitoring and Evaluation, 2011; Statistics South Africa, 2017a). All GHS data can be obtained from the DataFirst Portal of the University of Cape Town in SA (StatsSA, 2019).

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 (WHO, 2018).
- Resources exploring the WHO Quality of Care Framework for maternal and new-born health (Brizuela et al., 2019; Tunçalp et al., 2015).
- Global Review of Key Interventions related to reproductive, maternal, newborn and child health (PMNCH, 2011).
- Guidelines for positive birth experience with a focus on monitoring Intrapartum care (World Health Organization, 2018b).
- Quality of care at primary (Ideal Clinic Realization and Maintenance Program) and hospital (National Core Standards) level in SA (Department of Health, 2018b; Department of Health, 2011).

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 (CSDH, 2008), conceptual framework of the social determinants of health (Solar & Irwin, 2010), and frameworks for practice at country level (WHO, 2011). 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.

Figure 2 Description of indicators and gaps in monitoring interventions along the continuum of care for maternal health in South Africa

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 (NCCEMD, 2016). 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 (Benova et al., 2019).

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.

<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

<i>Dimension</i>	<i>Level of care</i>	<i>Intervention package</i>	<i>Indicators/proxies available</i>
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 (Mothupi, 2018). 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.

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 (Department of Health, 2012e). 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 (Graham & Varghese, 2012). 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 (Wright et al., 2017). 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 (NCCEMD, 2016). Referrals encompass not only transport but also matching skills to patient needs and managing congestion in facilities (NCCEMD, 2016). 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 (Kikuchi et al., 2015; Pattinson et al., 2003). The CoC framework improves on the country’s strategic plan because it includes more social determinants than water and sanitation (Department of Health, 2012e). Other frameworks propose even more social determinants, such as occupation, social class, race and ethnicity, social environment and psychosocial circumstances, and behavioural factors (Solar & Irwin, 2010). 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

(Please see [Acronyms/Abbreviations](#) section)

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,

[\[https://www.datafirst.uct.ac.za/dataportal/index.php/catalog/central\]](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,
[\[https://dd.dhmis.org/\]](https://dd.dhmis.org/)[7].

Competing interests

The authors declare that they have no competing interests

Funding

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Authors' contributions

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

Acknowledgements

Not applicable

References

(please see [Reference](#) section)

Figures, Tables and Additional Files

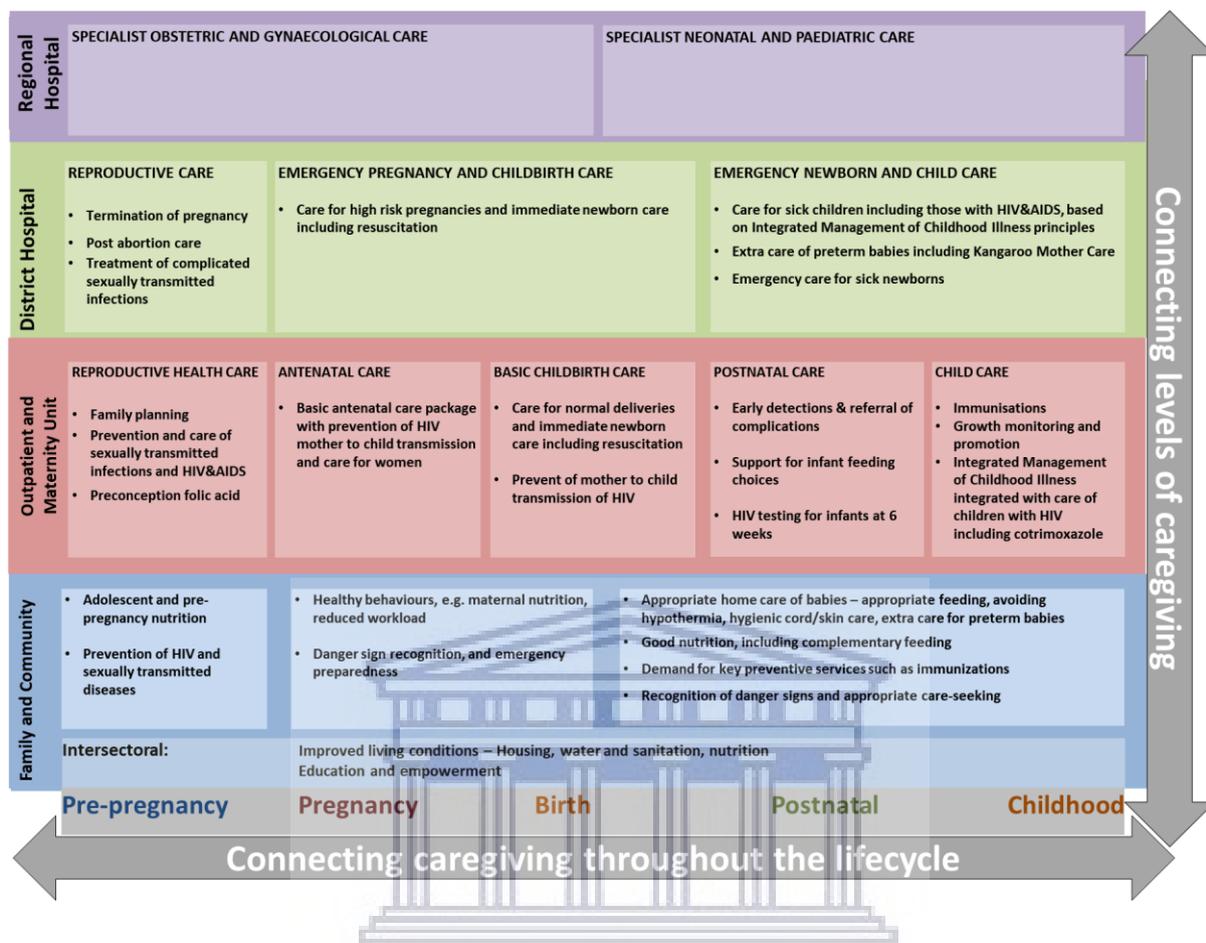


Figure 1. Continuum of care framework for maternal and newborn health in South Africa (Source: Bradshaw et al, 2008). The continuum of care framework for South Africa was developed by national health system stakeholders and decision makers [2]. It outlines important evidence-based interventions to improve 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 package	Indicator(s)	Data Source	Description	Gaps
1-2	Pre-pregnancy/Community	Reproductive Health	Female and male condom distribution coverage	DHIS	Condoms distributed from a primary distribution site to health facilities or points in the community (e.g.	There is need to monitor screening and vaccination for Human Papilloma Virus (HPV) as per new policy of vaccinations to school going girls.

Level of care	Intervention package	Indicator(s)	Data Source	Description	Gaps	
3	Adolescent/Preconception nutrition	Mills fortification compliance rate	DHIS	Operational flour and maize milling establishments that were compliant with fortification Regulation under the FCD Act as a proportion of milling establishments that were inspected.	This indicator reflects community level exposure. More indicators can be explored that are directly related to adolescent and preconception nutrition, such as provision of micronutrient supplementation.	
4	Pre-pregnancy /Primary health facility	Reproductive Health	Couple year protection rate	DHIS	Women protected against pregnancy by using modern contraceptive methods, including sterilisations, 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 – 0-12 weeks rate, 13-20 weeks rate and under 20 years rate	DHIS	Pregnancies terminated in health facilities in at specified gestation period time, or age of woman, 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 health behaviours. In addition, the MomConnect platform which distributes cellphone messages for pregnant women can promote healthy behaviours. It is important to monitor the promotion of healthy behaviours through these interventions and antenatal care services.	
		Danger sign recognition and emergency preparedness			Indicators that monitor interventions such as MomConnect which uses cellphone messages to promote healthy pregnancies need to be integrated into the DHIS as scale up in public health facilities in the country increase.	
9	Pregnancy/Primary health facility	Antenatal Care (with PMTCT)	Antenatal 1st visit before 20 weeks rate	DHIS	Women who have a booking visit (first visit) before they are 20 weeks into their pregnancy as proportion of all antenatal 1st visits	Monitoring of content of care during antenatal care as included in clinical management modules of the Ideal Clinic quality improvement assessment tools.
10			Antenatal 1st visit coverage	DHIS	The proportion of potential antenatal clients coming for at least one (booking) antenatal visit. The census number of children under one year factorised by 1.15 is used as a proxy denominator - the extra 0.15 (15%) is a rough estimate to cater for late miscarriages (~10 to 26 w), stillbirths (after 26 weeks gestation) and infant 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	
11			Antenatal client HIV re-test rate: retesting	DHIS	Antenatal clients re-tested for HIV as proportion of antenatal clients tested negative for 1st HIV tests	Besides HIV, there is need to integrate monitoring indicators for TB diagnosis and treatment.

Level of care	Intervention package	Indicator(s)	Data Source	Description	Gaps	
12		among positive HIV clients		done during current pregnancy		
12		Antenatal client start on ART rate	DHIS	Antenatal clients who started on ART as a proportion of the total number of antenatal clients who are HIV positive and not previously on ART		
13-15		Syphilis positive pregnant female receive Benz-penicillin 1 st , 2 nd and 3 rd dose rate	DHIS	Syphilis positive pregnant females who received Benz-penicillin 1 st , 2 nd or 3 rd dose as a proportion of pregnant females who tested positive for syphilis		
16	Pregnancy/ District hospital	Reproductive Care	Emergency pregnancy care	DHIS	Need for indicators of high risk pregnancy care to be integrated into the DHIS	
16	Birth/Primary health facility	Care for normal delivery and PMTCT	Delivery in facility rate	DHIS	Deliveries in health facilities as proportion of expected deliveries in the population. Expected deliveries are estimated as population under 1 year multiplied by 1.025 to compensate for still births and infant mortality	Indicators for management of post-partum haemorrhage and other quality of care signal functions during childbirth needed.
17	Birth/ District hospital	Emergency childbirth care	Delivery by caesarean section rate	DHIS	Delivery by Caesarean section as proportion of total deliveries in health facilities	Need to monitor quality of care during Caesarean deliveries
18	Post-natal care/ Community	Recognition of danger signs and care-seeking			Outreach to households (OHH) with postnatal care indicators may include recognition of danger signs and care seeking. However, current indicators only monitor 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	Mother postnatal visit within 6 days rate	DHIS	Mothers who received postnatal care within 6 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	Cross-cutting	Ideal Clinic Status rate	DHIS	Score out of 100 based on multidimensional measure of quality environment with some signal functions for maternal health; reflects national priorities at primary care level. The main dimensions include 1. Administration 2. Integrated Clinical Services Management 3. Medicines, Supplies and Laboratory Services 4. Human Resources for Health 5. Support Services 6. Infrastructure 7. Health Information Management 8. Communication 9. District Health System Support 10. Implementing Partners and Stakeholders. All main dimensions have sub-components and specific elements to be measured.	May be supplemented with more detailed signal function 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 Ideal Clinic related data.

	Level of care	Intervention package	Indicator(s)	Data Source	Description	Gaps
21	Quality of care/ District Hospital	Cross-cutting	Hospital achieved 75% and more on National Core Standards (NCS) self-assessment rate	DHIS	Score out of 100 on a multidimensional measure of quality environment, without signal functions for maternal health. Availability of guidelines for clinical management of gynaecological/obstetric conditions assessed via the NCS. 1: Patient Rights 2: Patient Safety, Clinical Governance and Clinical Care 3: Clinical Support Services 4: Public Health 5: Leadership and Governance 6: Operational Management 7: Facilities and Infrastructure.	May be supplemented with more detailed signal function data e.g. from the department's maternal death audits and observational data.
22-23	Linkages of care/ Crosscutting	Cross-cutting	Obstetric emergency inter-facility transfer rates	DHIS	Emergency obstetric inter-facility transfers response times under 60 minutes as a proportion of EMS obstetric rural inter-facility transfers; Emergency obstetric inter-facility transfers response times under 30 minutes as a proportion of EMS obstetric urban inter-facility transfers	Linkages across packages of care can be explored through research and formulation of new indicators
24-26			Obstetric response times and client transport rates	DHIS	Obstetric clients as a proportion of total EMS clients transported	
27	Cross-cutting/Community (Intersectoral Factors)	Water and sanitation	Environmental Health: Domestic water compliance rate	DHIS	Domestic bacteriological and chemical water samples taken from Water Services Authorities and water service intermediaries at a point of use that conform 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 their Environmental Health assessment.
28		Water and sanitation	% women 15-49 drinking safe water	GHS	Proportion of women 15-49 in households that perceive their water to be safe	
29			% women 15-49 in households with adequate water infrastructure	GHS	Proportion of women 15-49 in households with adequate water supply infrastructure	
30			% women 15-49 with basic sanitation facility	GHS	Proportion of women 15-49 in households with basic sanitation facilities.	
31		Housing	% women 15-49 with access to electricity	GHS	Proportion of women 15-49 in households with access to electricity	Exploration of more reliable measures of indoor air pollution; current variables integrate both outdoor and air pollution from the perspective of households.
32			% women 15-49 living in adequate housing	GHS	Proportion of women 15-49 living in households with "good" or "very good" wall,	

Level of care	Intervention package	Indicator(s)	Data Source	Description	Gaps
33		% women 15-49 living in formal housing	GHS	roof, and floor condition of the dwelling. Proportion of women 15-49 in housing classified as formal housing (by Regional Development Plan (RDP) plan of the country)	
34	Nutrition	% women 15-49 who have adequate food access	GHS	The mean proportion of women 15-49 in households that "never" had insufficient food, run out of money for food, cut the size of meals, skip a meal, or small variety of meals.	May be supplemented with other sources of data on macro and micronutrient variety. Intervention/nutrition counselling (health promotion) on lifestyle factors that impact dietary outcomes e.g. alcohol.
35		Household Dietary Diversity Score	GHS	The Household Dietary Diversity Score by consumption of between 0-10 food groups, in households with women 15-49 years of age	Monitoring of interventions to address outcomes such as post-partum weight retention and consideration of a maternal minimum dietary diversity scale for women. Dietary diversity may also not indicate the quantity and quality of food consumed.
36	Education	% women 15-49 who are literate	GHS	Proportion of women 15 - 49 who achieved grade 8 or more	
37	Empowerment	% women 15-49 with medical aid	GHS	Proportion of women 15-49 who have medical aid	Multifaceted domain whose indicators can extend to household income levels and demand for care. In addition, women's decision making power in households and health facilities (across the continuum of their health needs, from reproductive through birth experience and postnatal). Gender based violence as a detrimental influence on empowerment.
38		% women 15-49 with income source	GHS	Proportion of women 15-49 with at least one of social grant, working for wage/commission/salary, or involved in business activities.	

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.

Chapter 5 – Experts’ perspectives on indicators and the framework

Chapter 5 was published as a peer-reviewed research article titled “Improving the validity, relevance and feasibility of the continuum of care framework for maternal health in South Africa: a thematic analysis of experts’ perspectives.” Author(s): Mamothena Mothupi, Lucia Knight, Hanani Tabana 2020 *Health Research Policy and Systems*/ 18(28)/ <https://doi.org/10.1186/s12961-020-0537-8>

This chapter presented the research on experts’ perspective on the CoC framework and indicators proposed in Chapter 4. The framework and indicators both needed to be appraised by experts in the health system and relevant sectors who were more likely to use them. These experts would have familiarity with the indicators proposed in Chapter 4, as they are currently used for policy and planning in public health in South Africa. While there is literature to support the selection of each indicator in the CoC, expert appraisal provides an additional layer of validation and allows reflection on feasibility. The indicators selected had original uses and the expert inputs helped to understand their new role in the CoC framework. There were literature gaps in user perspectives of the CoC framework identified in Chapter 1 and Chapter 5 contributes this knowledge using experts from South Africa and relevant LMIC contexts. This chapter also supports the overall interpretation of the CoC framework and indicators, by assessing themes related to validity, relevance and feasibility. From these themes, the author was able to interpret findings on CoC framework measurement and monitoring in South Africa in later chapters, with implications for other LMICs.

Improving the validity, relevance and feasibility of the continuum of care framework for maternal health in South Africa: a thematic analysis of experts' perspectives

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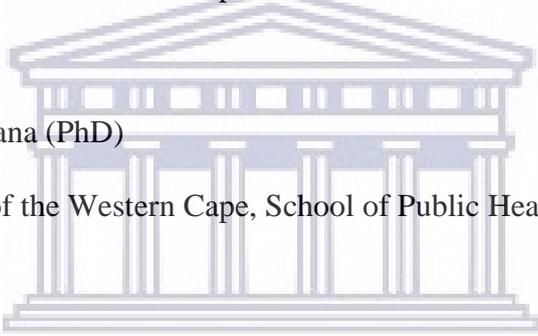
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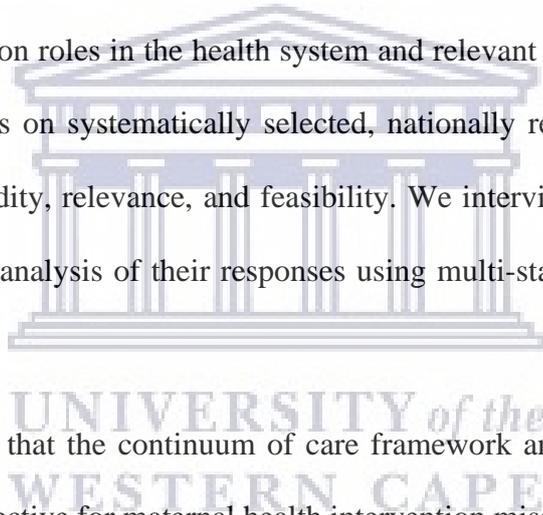
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Abstract

Background: The continuum of care is a key strategy for ensuring comprehensive service delivery for maternal health, while acknowledging the role of the social determinants of health. However, there is little research on the operationalization of the framework by decision makers and implementers to address maternal health challenges. The framework should be measurable and feasible for implementation in low- and middle-income country (LMIC) contexts. In this study we explore experts' perspective on monitoring indicators for continuum of care and key issues related to their use in the South African context.

Methods: We conducted key informant interviews with a range of experts in decision-making and program implementation roles in the health system and relevant sectors. Key informants provided their perspectives on systematically selected, nationally representative monitoring indicators in terms of validity, relevance, and feasibility. We interviewed 13 key informants and conducted a thematic analysis of their responses using multi-stage coding techniques in Atlas.ti 8.4.

Results: Experts believed that the continuum of care framework and monitoring indicators offer a multisectoral perspective for maternal health intervention missing in current programs. To improve validity of monitoring indicators, experts suggested reflection on the use of proxy indicators and improvement of data to allow for equity analysis. In terms of relevance and feasibility, experts believe there was potential to foster co-accountability using continuum of care indicators. However, as experts stated, new indicators should be integrated that directly measure intersectoral collaboration for maternal health. In addition, experts recommended that the framework and indicators should evolve over time to reflect evolving policy priorities and public health challenges.



Conclusion: Experts, as decision makers and implementers, helped identify key issues in the application of the continuum of care framework and its indicators. The use of local indicators can bring the continuum of care framework from an under-utilized strategy to a useful tool for action and decision-making in maternal health. Our findings point to measurement issues and systematic changes needed to improve comprehensive monitoring of maternal health interventions in South Africa. Our methods can be applied to other LMICs using the continuum of care framework and locally available indicators.

Keywords: maternal health, continuum of care, framework, indicators, relevance, feasibility, validity, qualitative



Background

A review of national and global sources estimates maternal mortality for South Africa between 138 to 157.9 deaths per 100,000 live births in 2015 (Day et al., 2018). This is an improvement from the range of 140 to 174.1 deaths per 100,000 live births in 2013 (Day et al., 2018). The latest South African Demographic and Health Survey shows an increase in pregnancy related mortality ratio (number of pregnancy related deaths per 100,000 live births) from 150 in 1998 to 536 in 2016 (Department of Health et al., 2019). Pregnancy related deaths are classified as any deaths from any cause occurring during the “maternal risk period” from pregnancy to 6 weeks postpartum (Garenne et al., 2013). The measure is sometimes used in South Africa due to challenges in estimation of the maternal mortality ratio (Department of Health et al., 2019). Based on the resources the country invests in health, these estimates for maternal and pregnancy related mortality should be lower (Rispel, 2016); they should reflect better progress towards the Sustainable Development Goals target for maternal mortality (a national goal of below 100 deaths per 100,000 live births) (Department of Planning Monitoring and Evaluation, 2019).

A continuum of care approach has been recommended for the country to improve maternal health outcomes (Bradshaw et al., 2008; Department of Health, 2016; PMNCH, 2011). Continuum of care for maternal health is the delivery of a myriad health promotion, preventive and curative interventions from pre-conception to post-natal care (Bradshaw et al., 2008; Kerber et al., 2007; PMNCH, 2011). It is defined as *“access to care provided by families and communities, by outpatient and outreach services, and by clinical services throughout the lifecycle, including adolescence, pregnancy, childbirth, the postnatal period, and childhood. Saving lives depends on high coverage and quality of integrated service-delivery packages throughout the continuum, with functional linkages between levels of care in the health system*

and between service-delivery packages, so that the care provided at each time and place contributes to the effectiveness of all the linked packages.”(Kerber et al., 2007). Delivery of a continuum of care for maternal health is integrated with child health interventions, although in this study we focus only on the former. The aim of the continuum of care approach is to improve the efficiency and effectiveness of health service organization; it increases integration of services and reduces duplication of effort, increases linkages between different stages and levels of care and, ultimately, improves health outcomes and outcomes of care (de Graft-Johnson et al., 2006; Kerber et al., 2007).

National stakeholders in the South African health system (the Department of Health and partner organizations) outlined a continuum of care framework as presented in Figure 1 (Bradshaw, et al., 2008). The framework serves to frame health policy and planning by promoting comprehensive service delivery involving all levels of the system across the lifecycle. It also highlights the importance of the social determinants of health acting at the community level of care to influence health outcomes. The social determinants of maternal health include structural determinants related to governance and policies as well as cultural and social values (Khanna & Sri, 2020; WHO, 2011). In addition, the community context of living and other material conditions, social capital and social cohesion, health system, behavioural and psychosocial, and biological factors also influence maternal health outcomes as intermediary determinants (Khanna & Sri, 2020; WHO, 2011). In the South African framework, there is a focus on “intersectoral factors” which cross-cut a few social determinants of health. The South African health system aims to improve maternal health through multisectoral action to address social determinants of health (Bhardwaj et al., 2018; NCCEMD, 2016b; Pillay & Barron, 2018). The current framework differs from other models that typically define the continuum of care for

maternal health only from pregnancy to postnatal period, with the exclusion social determinants (Mothupi et al., 2018).

The current strategic framework for maternal health in South Africa envisions future monitoring and evaluation of services from a continuum of care perspective (Department of Health, 2012e). Quality of care initiatives also recommend action on the continuum of care to improve maternal health in South Africa (NCCEMD, 2016b). Although the strategic goal exists, as yet there is no defined approach for planning of services and monitoring of performance along the continuum of care. There is a research gap in defining and validating a comprehensive set of indicators that can be used to assess and monitor the continuum of care for maternal health in the country. Implementing and monitoring the comprehensive set of services on the continuum will complement current quality of care efforts in the health system to improve maternal health outcomes.

In a preliminary study (Mothupi et al., 2019), we used the continuum of care framework in Figure 1 to guide identification of relevant indicators for all services, using local data sources. These data sources included the South African district health information system and household surveys. The aim was to propose a set of indicators for monitoring the continuum of care for maternal health in South Africa. The available indicators are currently used in programs to monitor various maternal health and community interventions. In this study we ask experts to reflect on their potential use within the continuum of care framework. Using existing indicators relieves the data collection burden from an already overwhelmed health system workforce.

For existing indicators to support policy and program decision making, they have to be valid, relevant and feasible for the new context in which they are intended (Blas, Ataguba, et al.,

2016; Ross et al., 2001; Sherr et al., 2017). To expand on the preliminary study which identified the indicators, in this study we aim to explore experts' perspectives on key issues that arise in re-orienting indicators to monitor the continuum of care. The purpose of the study is to strengthen the continuum of care framework and improve its potential use in maternal health policy and planning. The study is part of a larger project to identify, evaluate and use available indicators to track continuum of care performance for maternal health in South Africa.

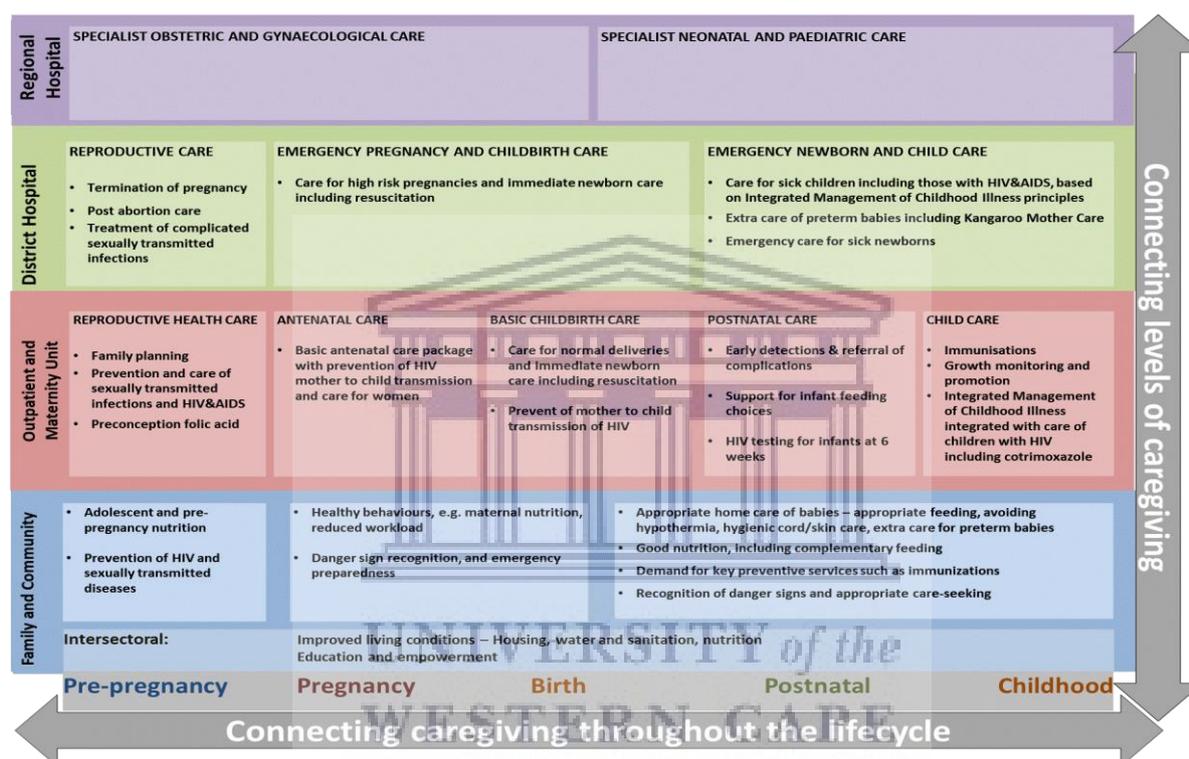


Figure 3 Continuum of care framework for maternal health in South Africa (Bradshaw et al., 2008).

Methods

Aim

The aim of this study was to assess experts' perspectives of the validity, relevance and feasibility of selected indicators and the indicator framework for continuum of care for maternal health in South Africa. The study complements others in a larger project which

identified the relevant indicators (Mothupi et al., 2018; Mothupi, Knight, et al., 2020a) and will be used in the future to assess performance.

Design

We conducted semi structured key informant interviews with policy and program decision makers from the health system and other sectors. We focused on the framework and the domains of empowerment, nutrition and quality of care in particular. Our preliminary research had shown that *quality of care* was a weak area of continuum of care measurement (Mothupi et al., 2018); *empowerment* and *nutrition* are broad and multidimensional domains that needed further contextualization for South Africa. The use of specific indicator domains also helps to delve into the thematic issues affecting the validity of the indicators in general. The individual indicators used present an opportunity for participants to elaborate by making concrete examples from the indicator framework.

Preliminary research

Indicators that were selected from local data sources using criteria developed by the authors. The criteria were 1) frequent data collection, 2) reliability, 3) already in use in policy and decision making in South Africa 4) alignment with the continuum of care framework, and 5) nationally and sub-nationally representative data (Mothupi et al., 2019). The National Indicator Data Set (NIDS) of the district health information system (DHIS) of South Africa was used to select health service indicators; and the annual General Household Survey (GHS) used to select data on services related to social determinants of health (Mothupi et al., 2019). These indicators are presented in the attached Table 1.

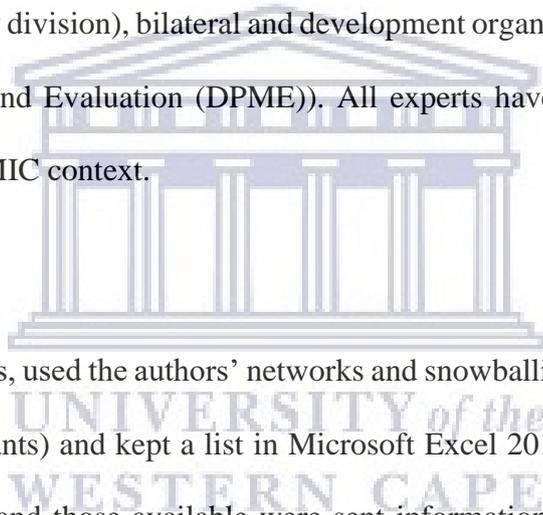
Table 1: List of indicators across the continuum of care for maternal health in South Africa

Participants

We sought a purposeful sample of experts, with variation in experiences across maternal health policy and programs, social determinants of health, monitoring and evaluation, and multisectoral collaboration. Our sample included 5 experts from the health system (national and provincial Department Of Health (DOH)) working in maternal health policy and program design, monitoring and evaluation (M&E) and quality assurance; 4 academics with experience in maternal health and social determinants of health (such as public health nutrition and empowerment); and 4 experts with experience in multisectoral collaboration to address social determinants of health (from Department of Agriculture, Forestry and Fisheries (DAFF) (nutrition and food security division), bilateral and development organizations, and Department of Planning, Monitoring and Evaluation (DPME)). All experts have experience working in South Africa or similar LMIC context.

Data collection

We searched online sources, used the authors' networks and snowballing techniques to identify experts (potential participants) and kept a list in Microsoft Excel 2010. Potential participants were contacted via email and those available were sent informational material ahead of the scheduled interview. The informational material introduced the study and provided the table of indicators on which experts based their responses (Table 1). The interview guide and consent form were also sent ahead of the interview. Before data collection, the interview guide was tested on four (4) suitable experts that were not part of the study sample and refined for clarity of questions. After refining the guide, the interviews were conducted among 13 experts between January and May 2019. We contacted 19 experts, 16 confirmed participation, and only 13 were interviewed due to time constraints on experts' part. One author (MM) interviewed



the participants in face to face meetings and via telephone. The open-ended nature of interview questions, as well as probing by the interviewer, reduced telephone participants' likelihood to put less effort in responses (satisficing). Interview questions were not of a personal or sensitive nature, thus reducing social desirability bias and lack of trust that may occur in telephone interviews. Similarly, the nature of questions did not impede response quality due to the lack of anonymity in face to face interviews. The interviews lasted between 40 minutes to an hour. The researcher took notes during and immediately after interview using Microsoft Word 2010; data was entered into Atlas.ti 8.4 for coding and analysis.

Data Analysis

The three themes of validity, feasibility and relevance guided the design of the open-ended interview guide and *a priori* coding of responses: these themes are defined in Box 1. Validity referred to experts' opinion of the suitability of indicators to measure and monitor specific domains. Relevance and feasibility refer to experts' perspective on the whether the framework and its indicators can

Validity: The suitability of indicators for measurement of their specific domain(s) and have a relationship with maternal health outcomes.

Relevance: The framework and indicators are seen as useful by decision makers and implementers in the country and can support policy and programmatic action

Feasibility: The information for the framework and indicators can be easily be understood, acquired and used for maternal health policy and programs in the country.

Box 1 Definition of validity, feasibility and relevance themes that guided the first phase of thematic analysis (adapted from Blas et al 2017)

support action and decision making in the health system, as well as multisectoral collaboration for maternal health. These concepts were adapted from Blas et al.'s (2016) study of the measurement and monitoring of social determinants of health in LMICs. In Box 1 we merge both technical (ease of data acquisition, analysis and interpretation) and policy and programmatic feasibility (messages from indicators are "communicable" and "comprehensible") as described by Blas et al (2016). Other interpretations of validity may

intertwine with relevance, and feasibility is an important consideration in the use of indicators (Benova et al., 2019).

We conducted in vivo coding of responses under the *a priori* themes, followed by closer analysis and open coding of emerging concepts. A third stage of coding involved the synthesis of emerging concepts into sub-themes (list coding), including any contrasting views. Multistage coding is an essential component of thematic analysis and helps with the layering of issues and development of themes in a transparent, rigorous manner (Fereday & Muir-Cochrane, 2006). One author was involved in the coding, and two authors were involved in the analysis.

Trustworthiness

Although using experts' perspectives to assess validity is considered the least rigorous validation method (Bolarinwa, 2015), it is the most justified in our study because the goal was to explore the framework and indicators by those likely to use them. In addition, all the indicators are already in use for decision making in their relevant sectors. We used a transparent and systematic approach for selecting indicators. The approach used a systematic review to define the measurement model for continuum of care for maternal health; local data sources for availability of indicators; and individual indicators based on evidence from published literature and policy documents (Mothupi et al., 2018; Mothupi et al., 2019). This study serves as a qualitative evaluative exercise meant to support the interpretation of the continuum of care framework and its indicators in the South African context.

Reflexivity

The framing of questions for the interviews reflects authors' knowledge and perspectives of what is important to explore, given current policy directions for maternal health in South Africa

and other LMICs. There are similarities between South Africa and other LMICs in terms of systemic priorities for addressing maternal health challenges, such as action on social determinants of health as well as improved quality of care and monitoring and evaluation. The main areas of interest were defined in advance and thus influenced the emergence of sub-themes. We defined validity, reliability and feasibility in advance because indicators are quantitative measures whose quality can be assessed from specific perspectives. Without guiding themes, participants could have probably had broader interpretations of the indicators and indicator framework.

Ethics

Institutional ethics clearance was obtained from the University of the Western Cape Biomedical Research Ethics Committee, as well as the departments where experts worked (where prior permission was needed). All transcripts were confidentially kept and are accessible only to authors, and names of experts are not included in the analysis and reporting.

Results

In this section we discuss key cross-cutting issues raised by participants regarding the framework and indicators of the continuum of care for maternal health. These issues emerged as sub-themes under the overarching themes of validity, relevance and feasibility.

Validity of the framework and indicators

According to participants, the framework and indicators provided a holistic, multisectoral perspective of interventions needed to improve maternal health in the country. Participants saw the framework as a good basis for thinking about future integrated monitoring and evaluation of maternal health. As a participant stated,

“These frameworks have a role because multisectoral action plans need to be monitored...The frameworks are useful to groups that care about the holistic perspective.” (Public health nutrition and M&E researcher, academic institution)

In multisectoral platforms, participants believe frameworks such as the continuum of care can help monitor interventions by different sectors towards improved maternal health outcomes. A participant with experience in multisectoral public health programs elaborates,

“Frameworks are useful for program design and to coalesce stakeholders around an idea; if there is buy in they can get everyone aligned around the same goals and strategies...It has to be the foundational basis if it is to be useful for monitoring and evaluation.” (Multisectoral program specialist, development organization)

Some of the indicators in the continuum of care framework already form part of national multisectoral strategic frameworks. From a multisectoral monitoring and evaluation perspective, a participant reflected:

“Continuum of care would fall under the outcomes monitoring, especially related to the Medium-Term Expenditure Frameworks (MTEF), which is what all departments use to set their strategic plans, including the Department of Health (DOH). So, from the MTEF the DOH will get the target of reducing maternal mortality in order to contribute to the national development plan. But there are also indicators in outcomes monitoring that are monitored for the improvement of maternal health – and this is about ARV [anti-retroviral drugs] access, antenatal care, attendance of early postnatal care etc...” (M&E specialist, DPME)

The MTEF is a multisectoral strategic budgeting framework used by the government to plan the country’s development through all its departments. Continuum of care, as a phenomenon,

is seen as an outcome that can be monitored to track the collective action of sectors. This implies the need for formulation of a composite outcome indicator for continuum of care from the existing set.

The validity discussion also led to the emergence of two sub-themes reflecting gaps and challenges perceived by participants, which were i) the use of proxy indicators and ii) measurement of indicators for sub-groups within maternal health.

Use of proxy indicators

Proxy indicators provide an indirect measurement of interventions and domains when direct data is not available. Participants felt that some of the proxy indicators used could not adequately measure interventions targeted for maternal health. An example was multidimensional quality of care, or the Ideal Clinic status indicator (Indicator 20, Table 1). This indicator measures quality of care from different dimensions at the facility level. Although it captures some maternal health components, it more broadly indicates the quality environment in which women and other population groups receive care. Thus the participants felt that the indicator should be supplemented by others that more specifically measured quality of care for maternal health. Similarly, the fortification of foods indicator (Indicator 3, Table 1) measures intervention at the community level, but not utilization by women of reproductive age.

Participants felt that the use of proxy indicators represented a compromise when data is unavailable. In the context of continuum of care, participants felt there needed to be a balance between collection of data on new, more direct indicators and their usefulness for decision making. As a respondent stated,

These are good indicators, and they are comprehensive enough because we don't even want to come up with too many indicators. Dietary diversity score [for example] is

based on food groups and although we may need to go deep into having macro – and micro – nutrient information, and measure the micro-nutrient adequacy score, these are used by specialists. What we have is adequate for programs and to inform us about the situation in South Africa. (Maternal health and nutrition researcher, academic institution)

Thus, there are indicators that may be useful for researchers but not policy and program implementers. For example, the dietary diversity score (Indicator 35, Table 1) is used in research and interventions that improve food security for individuals and populations. In contrast, other indicators related to nutrition may be outside of the scope of monitoring inputs/interventions along the continuum of care for maternal health.

Measurement for sub-groups

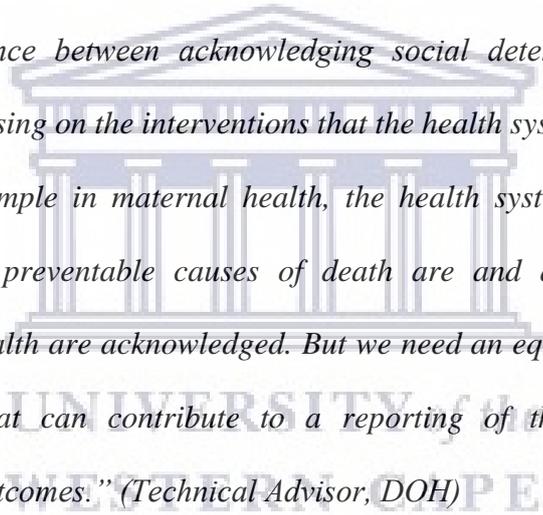
Participants reflected on measurement and monitoring of the indicators along the continuum of care, and the extent to which they represent services to sub-groups of women of reproductive age. As a non-homogenous population group for maternal health, women of reproductive age may have different barriers in accessing services along the continuum. For example, a participant states that the framework requires,

“...tweaking of some indicators to reflect the context of measurement. For example, the accessibility of the facility to people with disabilities. In the context of maternal health language disability is the most critical than physical disability” (Policymaker, DOH).

Tweaking then implies modification or integration of indicators that reflect local public health needs and promotes equitable service provision. Another example stated by participants was services to younger mothers, whose indicators can measure the quality elements of youth friendliness and interpersonal communication between providers and patients (i.e. patient

experience of care). When there is no sub-grouping, it may be difficult to design and monitor targeted services along the continuum of care that also address inequitable access. The rural and urban divide was another equity dimension mentioned by participants as influential on social determinants of health and access to care, and thus important to assess from the continuum of care perspective. Some indicators such as obstetric emergency transport in rural vs. urban areas (Indicators 22-26, Table 1) were a good demonstration of this stratification, according to participants. To the extent possible, other indicators should explore these subdivisions.

In terms of equity and the social determinants of maternal health, a participant stated,



“There is a balance between acknowledging social determinants of health are important and focusing on the interventions that the health system needs to do. For the most part, for example in maternal health, the health system works on their own evidence of what preventable causes of death are and addresses those. Social determinants of health are acknowledged. But we need an equity lens to the maternal mortality rates that can contribute to a reporting of the attribution of other determinants on outcomes.” (Technical Advisor, DOH)

Thus, the health system can also integrate social determinants of health data to help attribute maternal health outcomes to interventions and exposures outside of the health sector.

In summary, the participants felt that the framework and its indicators were valid in terms of providing a broad multisectoral perspective of maternal health intervention necessary to achieve and attribute outcomes. Validity could be improved by disaggregation of indicators to reflect maternal health subgroups for equity analysis, and collection of more direct data.

However, the collection of more data should be an exercise in balancing indicator utility and their precision.

Policy and programmatic relevance and feasibility

According to participants, the multisectoral nature of the indicators means that they can complement multisectoral collaboration for maternal health at strategic levels. Participants stated that there was various multisectoral work on-going between health and other sectors in South Africa, such as agriculture (nutrition and food security) and social development (women's empowerment). But these were restricted to the operational level without shared monitoring and evaluation frameworks. According to participants, this leads to a fragmentation in goals and perpetuates the current "silo" functioning of separate government departments. According to a participant,

"From the health perspective it has been about getting other sectors to do what health wants them to do. Which might not be best approach and a stumbling block" (Technical Advisor, DOH)

In contrast, a co-accountability mechanism for maternal health outcomes will use shared frameworks that integrate indicators from different sectors. According to participants, this solves the essential problem, whereby it is "...difficult to get sectors to care about the work that other sectors do, especially their monitoring indicators" (Public health nutrition researcher, academic institution). Using the example of the role of nutrition in maternal health outcomes, another participant states that,

"There are more than 60 programs in different government departments dealing with food security and nutrition – including health. Nothing much happens in multisectoral action - a coordinating department should be having an information management

system as a resource for anyone who wants to do research on food security and health”

(Technical Advisor and Program Co-ordinator, DAFF)

According to the participant, this points to the lack of relevant shared platforms and tools for cross-sectoral learning and research for informed decision making.

Two sub-themes emerged that relate to the main gaps and challenges related to relevance and feasibility of the framework and its indicators, which were i) lack of indicators for *intersectoral* action and ii) the need for the framework to reflect the evolving policy and public health context in the country.

Lack of indicators for intersectoral action

Participants reflected on whether the indicators adequately captured the interface between health and other sectors in multisectoral collaboration to improve maternal health outcomes. At the interface of the health system and other sectors, participants state that the continuum of care framework should include indicators that measure *intersectoral* action. According to a participant,

“This [the framework] doesn’t get at the intersectorality; thus, the multisectoral nature is clearly a second thought. There is no extra information on intersectoral expected interventions or domains...” (M&E specialist, development organization)

The inclusion of specific indicators for intersectorality, according to participants, may improve the relevance and use of the continuum of care framework in decision-making in the country.

Intersectoral indicators can include indicators of co-coverage, which measure efforts of multiple sectors simultaneously. As a participant elaborates: “A *co-coverage indicator will for instance look at impact of agriculture, water and education, gender all together at the*

household level” (Public health nutrition and M&E researcher, academic institution). This implies that a co-coverage indicator can be a composite metric of interventions by different sectors.

Besides intersectorality, participants also stated the need for harmonization of definitions and metadata to improve cross-sectoral use and interpretation. As an example, a participant compared how different sectors may define “child” – in civil registration as an individual below 16 years of age, in social development sector as below 18 years of age, and in the health sector the differentiation between children and adolescents. This logic can be applied to maternal health indicators within the continuum of care framework to ensure key concepts or sub-groups are described uniformly. Harmonization and intersectorality can thus enhance the ability to use indicators within multisectoral collaboration for maternal health.

The importance of local policy and public health context

According to participants, the relevance of the indicators can be enhanced by their alignment with current priorities for maternal health in the country. These priorities reflect subnational action and targets in maternal health services as well as the prevailing social determinants of health. In terms of services, participants noted gaps in measurement of maternal nutrition and mental health interventions at the health facility level. In terms of social determinants of health, participants reflected on the need for more empowerment factors and their impact on maternal health. In particular, issues of gender-based violence and coercion were relevant as they were prevalent in the country and affect women’s reproductive choices, pregnancy experiences, child health outcomes and maternal mental health. According to participants, the current framework should reflect these missing and crucial services and indicators. As one participant stated: *“It is important to have a framework, but the framework should not be set in stone and*

need to be updated every five years with latest data” (Empowerment and maternal health researcher, academic institution). These data will be reflective of emerging policy issues and public health concerns, and thus keep the framework and its indicators relevant to context.

Another aspect related to new policy priorities is respectful maternal care, which emphasizes positive birth experiences for women delivering in facilities. According to a participant, indicators are needed that monitor the continuum of care from the patient perspective: current indicators are heavily oriented towards provision of services, and not enough on how patients experience care. Participants raised more contextual issues such as health literacy challenges and women’s traditional roles in South African households, which is tied to their empowerment and may affect their health and nutrition outcomes. The reflection on relevance thus reveals entangled contextual factors and highlights their necessity if the framework is to continually reflect the environment it is intended to monitor. Some of these factors are already reflected in the framework (e.g. empowerment) and others need to be collected in future iterations as data becomes available (e.g. maternal mental health, respectful maternal care).

In summary, the relevance and feasibility of the framework is centred on the potential to flatten out the current vertical or “silo” mentality of sectors, persistent even in multisectoral platforms. However, improvements need to be made to include indicators of concomitant impact of multiple sectors/intersectorality. And the framework should continue to evolve and reflect emerging policies, public health challenges and health services that impact maternal health outcomes in South Africa.

Discussion

One of the important ways to improve maternal health outcomes in South Africa is to strengthen health service monitoring to support planning and accountability in the health

system (Bamford, 2012). From a public health perspective, this also means acknowledging social determinants of health and their role in maternal health (Rispel & Nieuwoudt, 2012). Our study assessed experts' perspectives on potential monitoring indicators for the maternal health continuum of care in South Africa. Participants in our study believed that the continuum of care framework and the selected indicators provided a needed multisectoral perspective of maternal health interventions in South Africa. This multisectoral perspective, according to participants, can serve as a foundation for integrated monitoring of health and non-health sector interventions, and shared accountability for maternal health outcomes in the country.

The indicators appraised by participants in this study show that gaps remain in reporting services along the continuum of care. For the health sector, there are gaps in indicators because not all services are reported in the health system (English et al., 2011), and some are monitored through parallel information systems (Khumalo, 2006; Moodley et al., 2018). An example is quality of care, whose detailed audits are reported elsewhere and only composite indicators are included in the routine data set (Moodley et al., 2014). This affects accessibility of data (Moodley et al., 2014), and the lack of indicators for the framework. Other gaps, as identified by participants, were lack of indicators for experience of care, mental health and services to vulnerable groups (such as disabled women or young mothers). These gaps may be reflective of a lack of health service delivery in the country, not just reporting challenges. This is particularly true for maternal mental health services, which are lagging behind in primary health care in South Africa (Honikman et al., 2012; Petersen & Lund, 2011).

The framework of indicators needs to be continually improved to include the missing indicators when services and data become available. However, participants also highlighted the importance of balancing the need for more data with the utility of the indicators from a decision-making perspective. The use of already available indicators for new monitoring and

evaluation goals reduces the burden of data collection on health workers (Klazinga et al., 2001), and fulfils the goal of getting more intelligence out of the health data already available in South Africa (Department of Health, 2011a). Thus, we recommend the use of available data to measure and monitor the continuum of care, with a consultative process for additions/modifications to better align with evolving priorities.

Validity of indicators is affected by how well they measure the intended constructs. Sometime proxy indicators are used in the absence of direct measures. Participants believed that proxy indicators should be removed which reflect community coverage instead of the maternal health population. In the absence of alternatives however, such proxy indicators can remain until future improvements in measurement are made. Validating maternal health indicators should be an on-going process of re-evaluation to ensure that indicators are truly reflective of constructs and context (Benova et al., 2019).

Besides validity and gaps in measurement, participants also reflected on the relevance and feasibility of available indicators. For relevance, participants stated that indicators should appropriately reflect current policy priorities, social issues and public health challenges. South Africa has unique problems in maternal health including teenage pregnancy (Jonas et al., 2016), gender inequality and gender based violence (Cooper et al., 2004), inequitable access and quality of maternal care, as well as risky social exposures (Wabiri et al., 2013, 2016). There are age, race/ethnicity, residential, socioeconomic, disability and other differences in maternal health experiences among women in South Africa (Boerma et al., 2008; Fried et al., 2013; Wabiri et al., 2013; WHO & International Center for Equity in Health, 2015). Indicators need to reflect these disparities, in order to create buy-in from users and effectively support decision-making and action. To improve relevance of available indicators and the framework as a whole, we recommend strengthening of the health information system to collect data on disaggregation

variables and support equity analysis. The inadequacy of disaggregation data is a weakness of current health information system in South Africa and other LMICs (Agyepong et al., 2017; Day et al., 2018; Khumalo, 2006), and needs to be improved to support effective use of health service data in the future.

The feasibility of indicators was mainly tied to the perceived ease of use in intersectoral platforms, according to participants in this study. According to our study participants, there is a need to go beyond tracking sector performance individually and to integrate measurement of *intersectoral* collaboration for maternal health. Intersectoral collaboration refers to the mutually beneficial, integrated efforts of sectors who ideally share a common monitoring and evaluation framework (Rasanathan et al., 2015). According to our participants, intersectoral collaboration indicators would capture the true interface of the health system with other sectors. Intersectoral indicators are crucial because they have been used to address social determinants of health, and improve equity, accountability and planning for services in the era of the Sustainable Development Goals (Blas, Ataguba, et al., 2016; Blas, Roebbel, et al., 2016; Pega et al., 2017; Valentine & Bonsel, 2016). Currently, intersectoral indicators for reproductive, maternal and newborn and child and adolescent health are insufficiently measured and tracked (Rasanathan et al., 2015). Based on our findings, we recommend future research to document and develop indicators of intersectoral collaboration for inclusion in the continuum of care framework. In addition, we recommend future integration of data from other sectors, and intersectoral collaboration, into the health information system for accessibility and more comprehensive monitoring of interventions. The health system already acknowledges the need to integrate relevant non-health sector data and this needs to be implemented (Moodley et al., 2018; Pillay & Barron, 2018).

The experts who participated in our study are stakeholders who have insight on the possible implementation challenges and measurement gaps in the indicator framework for the continuum of care. In this way, the study identifies key issues for improvement of the indicator framework, to better support the goal for comprehensive monitoring and evaluation of maternal health in South Africa. We thus believe that this assessment of validity, relevance and feasibility of the indicator framework can be the basis for future its refinement and use in decision making and action for maternal health in South Africa. Similar studies can be conducted in other LMICs to enhance monitoring and decision making on multisectoral and comprehensive maternal service delivery. Studies should involve local stakeholders to help shape indicators that within-country priorities and support targeted decision making.

Limitations

Our study does not reflect all of the possible perspectives of stakeholders or experts in maternal health and determinants in South Africa. It is also not a consensus building process on how to improve the continuum of care framework, and which final list of indicators to use. Rather, it is a reflection by diverse stakeholders to identify key issues that can make the indicator framework implementable. Our study is also not a final validation of the indicators, as it is part of on-going research that will also use quantitative methods to measure the available indicators and derive composite metrics to track progress in health system performance in South Africa.

Conclusion

This study highlighted experts' perspectives on the framework and indicators for the continuum of care for maternal health in South Africa. The study provided insights into the potential utility of the continuum of care framework to maternal health planning and programming in South Africa. It provides recommendations from the perspective of decision makers and

implementers to improve use of valid, relevant and feasible indicators. The framework can be applied to assessment of comprehensive health services and monitoring and evaluation. Validity considerations focused on adjustment of indicators to measure maternal health more accurately. Indicators were relevant from a multisectoral perspective but did not sufficiently reflect current policy directions and contextual factors. To improve feasibility, indicators should also be amenable to future monitoring of intersectoral collaboration to address social determinants of maternal health. These findings help improve future measurement of indicators on the continuum of care for maternal health. They also point to systematic changes needed to improve monitoring of comprehensive maternal health service delivery in South Africa. These include future research in developing missing indicators, improved health service delivery, and strengthening health information systems to integrate data and indicators from other sectors. We recommend similar studies in other LMICs that involve stakeholders in repurposing and interpreting existing indicators, to reduce reporting burden and ultimately improve continuum of care monitoring in maternal health. These studies can support within country improvements in service delivery across the continuum, which complement global, cross-national goals for maternal health.

List of Abbreviations

(Please see the [Acronyms/Abbreviations](#) section)

Declarations

Ethics approval and consent to participate

Participants signed an informed consent form prior to commencement of interviews. Institutional ethics clearance was obtained from the University of the Western Cape Biomedical Research Ethics Committee, as well as the departments where experts worked

(where prior permission was needed).

Consent for publication

Not applicable

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request. No participant confidential information will be released.

Competing interests

"The authors declare that they have no competing interests"

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Authors' contributions

"MM and LK conceptualized the study. MM conducted data collection and analysis. LK guided additional analysis of data. MM, LK, HT were involved in writing and revision of manuscript.

All authors read and approved the final manuscript."

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Figures, tables and additional files

Figure 1 “Continuum of care framework for maternal and child health in South Africa”

Figure 1 legend: “Continuum of care framework for maternal and child health in South Africa”.

The figure shows the packages of interventions necessary for provision to mothers over time and place. The vertical dimension is place, which ranges from family and community level to regional hospital. The horizontal dimension is time, which ranges from pre-pregnancy to childhood. Each place dimensions is colour coded differently to highlight interventions needed at that level over time. Also crucial to the continuum of care, is connecting the vertical levels of caregiving (place), and connecting caregiving over the lifecycle (time). The interventions outlined for each level come from evidence-based guidelines and were decided consultatively for the South African government by the relevant health, scientific and development bodies stated on the report. Figure 1 is reproduced from a publicly available government report cited in this manuscript as “Bradshaw D, Chopra M, Kerber K, Lawn J, Moodley J, Pattinson R, et al. Every Death Counts: Saving the Lives of Mothers, Babies and Children in South Africa [Internet]. Every Death Counts: Saving the Lives of Mothers, Babies and Children in South Africa. Cape Town, South Africa; 2008 [cited 2018 Jun 9]. Available from: <http://www.mrc.ac.za/sites/default/files/attachments/2016-06-30/edcrptfinal.pdf>”. There are no permissions required to reproduce figures and tables produced by the national Department of Health and made available in public reports.

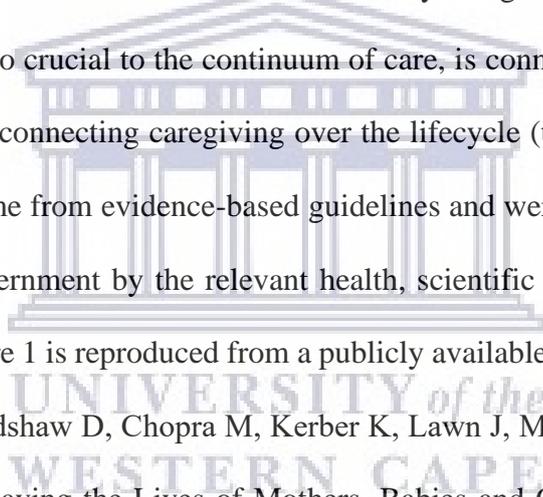


Table 1. List of indicators across the continuum of care for maternal health in South Africa

	Indicator	Definition
Reproductive Health		
1	Female condom distribution coverage	Number of female condoms distributed from a primary distribution site to health facilities or points in the community (e.g. campaigns, non-traditional outlets, etc.)
2	Male condom distribution coverage	Number of male condoms distributed from a primary distribution site to health facilities or points in the community (e.g. campaigns, non-traditional outlets, etc.)
3	Couple year protection rate	Number of women protected against pregnancy by using modern contraceptive methods, including sterilisations, as proportion of female population 15-49 years of age
4	Termination of pregnancy 0-12 weeks rate	Pregnancies terminated in health facilities in the first 12 weeks of pregnancy as a proportion of total termination of pregnancies
5	Termination of pregnancy 13-20 weeks rate	Pregnancies terminated in health facilities at 13-20 weeks of pregnancy as a proportion of total termination of pregnancies
6	Termination of pregnancy under 20 years rate	Termination of pregnancy under 20 years as a proportion of total termination of pregnancies in health facilities
Antenatal Care		
7	Antenatal 1st visit before 20 weeks rate	Women who have a booking visit (first visit) before they are 20 weeks into their pregnancy as proportion of all antenatal 1st visits
8	Antenatal 1st visit coverage	The proportion of potential antenatal clients coming for at least one (booking) antenatal visit. The census number of children under one year factorised by 1.15 is used as a proxy denominator - the extra 0.15 (15%) is a rough estimate to cater for late miscarriages (-10 to 26 w) still births (after 26 weeks gestation) and infant 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)
9	Antenatal client HIV re-test rate	Antenatal clients re-tested for HIV as proportion of antenatal clients tested negative for 1st HIV tests done during current pregnancy
10	Syphilis positive pregnant female receive Benz-penicillin 1st dose rate	Syphilis positive pregnant females who received Benz-penicillin 1st dose as a proportion of pregnant females who tested positive for syphilis
11	Syphilis positive pregnant female receive Benz-penicillin 2nd dose rate	Syphilis positive pregnant female receive Benz-penicillin 2nd dose as a proportion of pregnant females who tested positive for syphilis
12	Syphilis positive pregnant female receive Benz-penicillin 3rd dose rate	Syphilis positive pregnant female receive Benz-penicillin 3rd dose as a proportion of pregnant females who tested positive for syphilis
13	Outreach to households with pregnancy care rate	Outreach households (OHH) visits during which antenatal care was provided to pregnant women as proportion of households visited by the Ward Based Outreach Team

	Indicator	Definition
14	Antenatal client start on Antiretroviral treatment (ART) rate	Antenatal clients who started on ART as a proportion of the total number of antenatal clients who are HIV positive and not previously on ART
Delivery		
15	Delivery by Caesarean section rate	Delivery by Caesarean section as proportion of total deliveries in health facilities
16	Delivery in facility rate	Deliveries in health facilities as proportion of expected deliveries in the population. Expected deliveries are estimated as population under 1 year multiplied by 1.025 to compensate for still births and infant mortality
Postnatal Care		
17	Mother postnatal visit within 6 days rate	Mothers who received postnatal care within 6 days after delivery as proportion of deliveries in health facilities
18	Outreach to households with postnatal care rate	Outreach households (OHH) with postnatal care provided to a mother and/or neonate within 6 days after delivery as proportion of households visited by the Ward Based Outreach Team
Quality of Care		
19	Ideal clinic status rate	Fixed Primary Health Care health facilities that have obtained Ideal Clinic status. Ideal Clinic status is a score of 70% or more on assessment of the facility readiness to provide good quality of care along the following main dimensions 1. Administration 2. Integrated Clinical Services Management 3. Medicines, Supplies and Laboratory Services 4. Human Resources for Health 5. Support Services 6. Infrastructure 7. Health Information Management 8. Communication 9. District Health System Support 10. Implementing Partners and Stakeholders.
20	Hospital achieved 75% and more on National Core Standards (NCS) self-assessment rate	Hospitals that achieved a performance of 75% or more on National Core Standards self-assessment. National Core Standards measure 1: Patient Rights 2: Patient Safety, Clinical Governance and Clinical Care 3: Clinical Support Services 4: Public Health 5: Leadership and Governance 6: Operational Management 7: Facilities and Infrastructure.
Linkages		
21	Obstetric clients transport rate	Obstetric clients as a proportion of total EMS clients transported
22	Rural obstetric response under 40 minutes rate	Primary Obstetric calls responded to under 40 minutes in a rural area as a proportion of EMS (Emergency medical services) P1 rural obstetric calls total
23	Urban obstetric response under 15 minutes rate	Primary Obstetric calls responded to under 15 minutes in an urban area as a proportion of EMS P1 urban obstetric calls total
24	Obstetric emergency rural inter-facility transfer under 60 minutes rate	Emergency obstetric inter-facility transfers response times under 60 minutes as a proportion of EMS obstetric rural inter-facility transfers
25	Obstetric emergency urban inter-facility transfer under 30 minutes rate	Emergency obstetric inter-facility transfers response times under 30 minutes as a proportion of EMS obstetric urban inter-facility transfers
Social determinants of health		

	Indicator	Definition
26	Mills fortification compliance rate	Operational flour and maize milling establishments that were compliant with fortification Regulation under the FCD Act as a proportion of milling establishments that were inspected (Target 98%)
27	Domestic water compliance rate	Domestic bacteriological and chemical water samples taken from Water Services Authorities and water service intermediaries at a point of use that conform to the standards set out in SANS 241. for drinking water quality and safety as a proportion of water
28	% women 15-49 who are literate	Proportion of women 15 - 49 who achieved grade 8 or more
29	% women 15-49 with medical aid	Proportion of women 15-49 who have medical aid
30	% women 15-49 with income source	Proportion of women 15-49 with at least one of social grant, working for wage/commission/salary, or involved in business activities.
31	% women 15-49 with access to safe drinking water	Proportion of women 15-49 in households that perceive their water to be safe
32	% women 15-49 with basic sanitation facility	Proportion of women 15-49 in households with basic sanitation facilities.
33	% women in adequate water infrastructure households	Proportion of women 15-49 in households with adequate water supply infrastructure
34	% women with access to electricity	Proportion of women 15-49 in households with access to electricity
35	% women living in formal structures	Proportion of women 15-49 in housing classified as formal
36	% women living in adequate housing conditions	Proportion of women 15-49 living in households with “good” or “very good” wall, roof, and floor condition of the dwelling.
37	% women in households with adequate food access	The mean proportion of women 15-49 in households that “never” had insufficient food, run out of money for food, cut the size of meals, skip a meal, or small variety of meals.
38	Household Dietary Diversity Score (HDDS) (women 15-49)	Mean Household Dietary Diversity Scores (HDDS) for all women 15 -49 households: HDDS = 1 point for household consumption of each of 10 food groups, total score out of 10.

References

(please see [References](#) Section)

Chapter 6 – Development of the composite index for continuum of care

Chapter 6 was submitted as a research article titled “Development and testing of a composite index to monitor the continuum of maternal health service delivery at provincial and district level in South Africa” Author(s): Mamothena Mothupi, Jeroen De Man, Hanani Tabana, Lucia Knight. Journal: *Plos One* (Submitted May 2020, Status: With Editor – process for finding editor took a long time) The article can be found as a preprint on *Research Square*: <https://doi.org/10.21203/rs.3.rs-97082/v1>

This chapter presented the development of the composite index for summarizing indicator performance on the CoC. The index was called the Comprehensive Continuum of Care for Maternal Health Index, or C₃MH index. The C₃MH index integrated different indicators from the health and non-health sectors through a standardization approach developed and tested by the author. The standardized indicators were aggregated using a geometric mean in line with guidelines for composite index development. The indicators used were selected and assessed through the research process detailed in Chapters 4 and 5 and data from the North West province and its four districts was used to develop and assess the index. The measurement model for the index was based on the adequacy construct developed in Chapter 3. Chapter 6 contributes both the methodology for development and validation of the index and a description of CoC performance in the North West province for the period 2013-2017. Thus, recommendations regarding testing and evaluation of the index in other contexts within and outside of South Africa were made. In addition, recommendations on improving service provision and information sources in the North West province were also made.

Development and testing of a composite index to monitor the continuum of maternal health service delivery at provincial and district level in South Africa

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Abstract

Introduction: The continuum of care is a recommended framework for comprehensive health service delivery for maternal health and it integrates health system and social determinants of health. There is a current lack of knowledge on a measurement approach to be used to monitor performance on the framework. In this study we aim to develop and test a composite index for assessing the maternal health continuum in South Africa.

Materials and Methods: The composite index was computed as a geometric mean of four dimensions of adequacy of the continuum of care. Data was sourced from the district health information system, household surveys and the census. The index formula was tested for robustness when alternative inputs for indicators and standardization methods were used. The index was used to assess performance in service delivery in the North West province of South Africa, as well as its four districts over a five-year period (2013-2017). The index was validated by assessing associations with maternal health and other outcomes. In addition, factor analysis was used to assess the statistical dimensions of the index.

Results: The provincial level index score increased from 62.3 in 2013 to 74 in 2017, showing general improvement in service delivery over time. The district level scores also improved over time and our analysis identified areas for performance improvement. These include social determinants of health in some districts and access and linkages to care in others. The provincial index was correlated with institutional maternal mortality rates ($r_s = -0.90$, 90% CI = (-1.00, -0.25)) and the Human Development Index ($r = 0.97$, 95% CI = (0.63, 0.99)). It was robust to alternative approaches including z-score standardization of indicators. Factor analysis showed three groupings of indicators for the health system and social determinants of health.

Conclusions: This study demonstrated the development and testing of a composite index to monitor and assess service delivery on the continuum of care for maternal health. The index was shown to be robust and valid and identified potential areas for service improvement. A contextualised version can be tested in other settings within and outside of South Africa.



Introduction

Maternal health outcomes in South Africa (SA) remain poor despite national investments toward their improvement (Pillay & Barron, 2018; Rispel, 2016). The maternal mortality ratio (MMR) was estimated between 138 and 158 deaths per 100,000 live births in 2015 (Day et al., 2018). Pregnancy related and facility-based rates of maternal mortality are also high, estimated in 2016 at 536 per 100,000 and 135 per 100,000 respectively (Department of Health et al., 2019; Pillay & Barron, 2018). The major causes of maternal mortality include HIV infection, obstetric haemorrhage and hypertensive disorders (NCCEMD, 2016b). The prevailing challenges in maternal health in SA include: inequalities in health service access (Wabiri et al., 2016), poor coverage and quality of essential interventions (Bhardwaj et al., 2018), inadequate system wide improvements in quality of care (Pillay & Barron, 2018) and weak community health services (Pillay & Barron, 2018).

One of the key strategies to address maternal health challenges in SA has been to strengthen service provision at different levels of care, from the community to the district hospital (Bradshaw et al., 2008; Department of Health, 2012d; Statistics South Africa, 2015). The continuum of care for maternal and child health is a public health framework for outlining the essential interventions and addressing service delivery challenges (Kerber et al., 2007; WHO, 2005). The framework has been developed for low- and middle income countries (LMICs) (Kerber et al., 2007) and adapted by national health system stakeholders to the South African context, as illustrated in Fig 1.

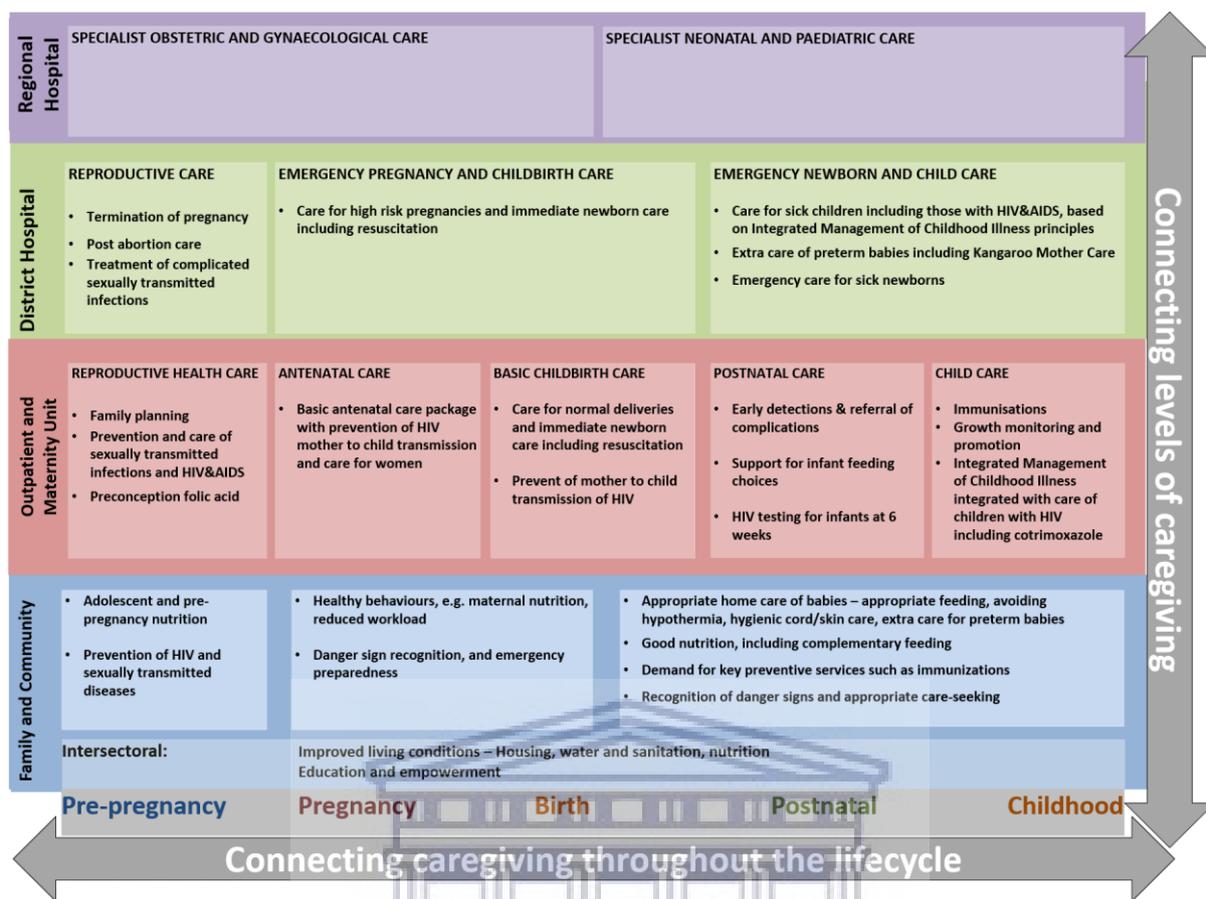


Fig 1. The continuum of care framework for maternal, newborn and child health in South Africa (Bradshaw et al., 2008).

The framework outlines interventions from pre-pregnancy to childhood; the maternal health interventions encompass reproductive health, antenatal, delivery and postnatal care. The framework for SA also outlines “intersectoral factors”, which represent social determinants of health such as housing, water and sanitation and education (Fig 1). The implementation of the framework is expected to improve health outcomes by improving coverage and comprehensiveness of services, mitigating duplication of resources and improving integration of health services (Bamford, 2012; Chopra, Daviaud, et al., 2009; Kerber et al., 2007).

A crucial barrier to the implementation of the continuum of care framework in SA and many LMICs is the lack of a comprehensive monitoring tool for service delivery (Department of Health, 2012d; Mothupi et al., 2018). The current discourse in SA focuses on the importance

of integrated delivery of services, strengthening community health systems and multisectoral collaboration to improve outcomes (Bamford, 2012; Chola et al., 2015; Department of Health, 2012d; Mayosi et al., 2012; Rispel, 2016). Maternal death audits have emphasized the importance of referral linkages, women's empowerment and postnatal follow-ups to improve maternal health outcomes in the country (NCCEMD & Department of Health, 2016). However, gaps remain in measuring community and social factors influencing maternal health outcomes (Moodley et al., 2014). Assessment of the continuum of care requires consideration of a broad set of indicators beyond antenatal, birth and postnatal care (Mothupi et al., 2018).

Previous studies by these authors reviewed and evaluated available indicators for tracking services on the continuum of care for maternal health in South Africa (Mothupi, Knight, et al., 2020a, 2020b). Another study by these authors proposed an analytical approach emphasizing assessment of access and utilization, quality of care, linkages of care and social determinants of health (Mothupi et al., 2018). Multidimensional assessment is often carried out with composite indices that summarize the performance of multiple interventions on the continuum. Composite indices have been used to track continuum of care performance at sub-national and global levels (Boerma et al., 2008; Kumar et al., 2013; Wehrmeister et al., 2016), while a gap remains in broader integration of quality and social determinants of health (Graham & Varghese, 2012; Mothupi et al., 2018). In this study, we explore an approach to combine a broad set of indicators for maternal health interventions on the continuum of care through development of a composite index. We explore if the index can be used to assess service delivery at sub-national levels in SA and the implications for future monitoring efforts to support implementation of the framework.

Methods

Setting

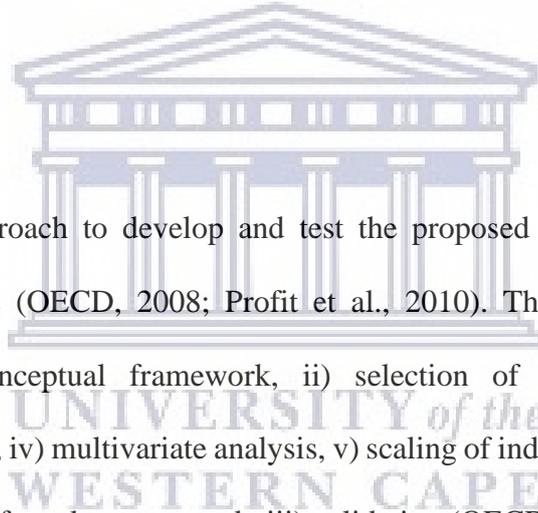
The North West province is one of the nine SA provinces and consists of four districts: Dr Kenneth Kaunda, Ngaka Modiri Molema, Dr Ruth Segomotsi Mompati, and Bojanala Platinum District Municipalities. This province is among the worst performers with regards to maternal health outcomes and health system indicators (Department of Health, 2018a). However, the province was also one of the pioneers of primary health care quality improvement and health system strengthening initiatives, such as the Ward Based Outreach and the primary level Ideal Clinic realization programs (Hunter et al., 2017; Schneider et al., 2018). Thus, the province was expected to have a broader set of available indicators across the continuum of care compared to others.

Design

We used a step-wise approach to develop and test the proposed index, based on current methodological guidelines (OECD, 2008; Profit et al., 2010). The main steps include: i) defining a theoretical/conceptual framework, ii) selection of variables/indicators, iii) imputation of missing data, iv) multivariate analysis, v) scaling of indicators, vi) weighting and aggregation, vii) checking for robustness, and viii) validation (OECD, 2008).

Conceptual framework

A critical interpretive synthesis of current measurement and monitoring approaches in LMICs found a gap in multi-dimensionality of sets of indicators currently used to assess the continuum of care (COC) for maternal health (Mothupi et al., 2018). The *adequacy construct* was therefore defined, which outlines four important dimensions to consider: 1) access and utilization of care; 2) quality of care; 3) linkages between levels and packages of care; and 4) social determinants of health (Mothupi et al., 2018) (Fig 2). The adequacy construct complements the COC



framework by adding elements of quality of and linkages to care and proposing that all four dimensions be monitored, not just access and or utilization. Indicators of service delivery across all dimensions should therefore be sought from local data sources, with consideration for their relevance, feasibility and validity (Mothupi et al., 2019b; Mothupi, Knight, et al., 2020).

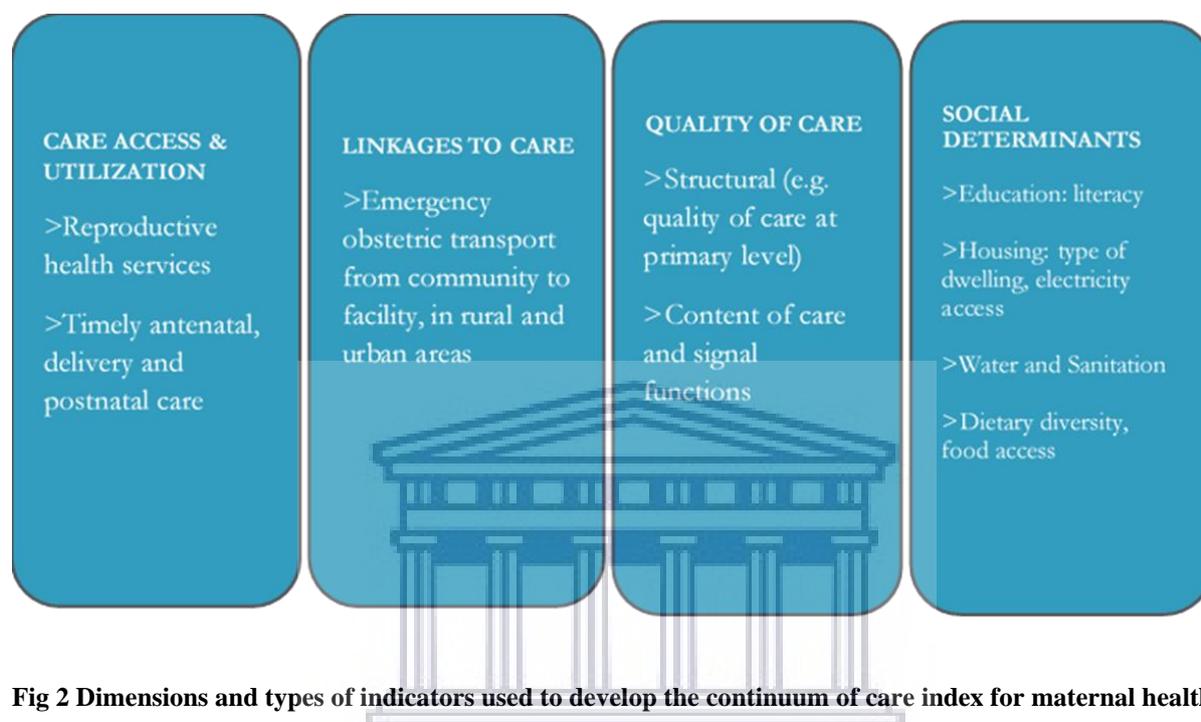


Fig 2 Dimensions and types of indicators used to develop the continuum of care index for maternal health
Selection of variables/indicators

A previous study assessed the suitability and measurement gaps of potential indicators for service delivery across the broad continuum in SA (Mothupi, Knight, et al., 2020). These indicators were extracted for the North West province and districts for the period 2013-2017. Health service indicators were sourced from the National Indicator Data Set (NIDS) of the District Health Information System (DHIS). The DHIS is used to report and monitor facility level data for health services to support policy and planning (Department of Health, 2011a). The DHIS provided indicators for access and utilization, linkages and quality of care dimensions of the continuum of care.

Social determinant indicators were sourced from the annual *General Household Survey (GHS) (2013-2017)* (StatsSA, 2020), *Census 2011* (Stats SA, 2020) and *Community Survey (CS) 2016* (StatsSA, 2017b). The census and CS enabled assessment at district level, even though they offer fewer social determinants of health indicators than the GHS. The census and CS provided indicators of literacy, housing, access to electricity, water, and sanitation at the district level. Additionally, the CS also assesses dietary behaviour and empowerment, but this was not included in the final analysis of performance to allow district level comparison with the census indicator set. A description of all indicators used in this study is provided in S1 Table. Indicator data were extracted, cleaned and analysed in MS Excel 2010, R v3.6.1 and STATA 14.0.

Imputation of missing data

Health service indicator data may be missing due to lack of services and under-performing systems for data collection and reporting. These systematic issues are considered to affect availability of data for indicators completely at random. As such, we conducted single value imputation using the indicator value observed from the adjacent year (Mikkelsen et al., 2017). In the Results section, we discuss the impact of the remaining data gaps on the index findings. Single value imputation was also applied to indicators from community survey and census to allow calculation of index at district level.

Multivariate analysis

We used exploratory factor analysis to assess dimensionality of the data, in order to compare the statistical and conceptual groupings of indicators (OECD, 2008). We assessed whether the data fitted the four dimensions of continuum of care proposed by the adequacy construct. The output of the exploratory factor analysis is assessed in the Results section.

Scaling of indicators

We conducted a linear transformation of indicator values on a scale between 0 and 100 (Booyesen, 2002) (Equation 1).

$$\text{Indicator score} = \text{Ideal Score} - |(\text{Target} - \text{Performance}) * 100| \quad (1)$$

The **indicator score** is calculated on a scale between 0 – 100; the **ideal score** is the maximum attainable score, which is a 100; the **target** is the ideal performance of the indicator; and **performance** is the observed value of the indicator during a given time period. Targets may consist of a range of values and in such a case, we calculated the median score to represent indicator performance. Targets were also based on national policy documents and global technical or scientific guidelines (Booyesen, 2002; OECD, 2008; Profit et al., 2010). Targets were set to the conservative maximum (100%) where guidelines were unavailable. The difference between target and observed performance is multiplied by 100 because indicators are originally measured as percentages/proportions. Using targets for performance improves the meaningfulness of the index and its' role in policy discourse (Barclay et al., 2019).

Weighting and aggregation

The comprehensive continuum of care for maternal health index (C₃MH index) was computed as a geometric mean of equally weighted sub-indices reflecting the four adequacy dimensions. We chose equal weighting since this was estimated the most reasonable approach and evidence on the relative importance of each sub-index is lacking (Noble et al., 2009; OECD, 2008; Profit et al., 2010).

$$\text{C}_3\text{MH index} = (\text{Access to care} \cdot \text{Linkages} \cdot \text{Quality of Care} \cdot \text{Social Determinants of Health})^{1/4} \quad (2)$$

Simple indices, based on arithmetic and geometric means, can be robust and give valuable information about public health or health system performance (Boerma et al., 2008, 2018;

Noble et al., 2009; Stern et al., 2014; Wehrmeister et al., 2016). Unlike the arithmetic mean, the geometric mean allows for a degree of non-compensation of performance of one indicator by another (OECD, 2008; Profit et al., 2010). Each sub-index (e.g. access to care) was also formulated as a geometric mean of its indicator scores.

$$\text{Sub index score} = (\text{Indicator}_a \cdot \text{Indicator}_b \cdot \text{Indicator}_c \cdots \text{Indicator}_n)^{1/n} \quad (3)$$

Where a, b, c are individual indicators and n = number of indicators within the sub-index.

Validity and Robustness

We ran sensitivity analyses comparing index performance with different indicator combinations and normalization methods (Hogan et al., 2018). We tested if z-score standardization leads to a shift in district ranks (OECD, 2008). Index performance was also compared after removal of indicators that were considered outliers (performed close to 100 %), missing data, or indicators that could be represented by a proxy (e.g. syphilis treatment measured with one indicator instead of the three across the treatment cascade, see S1 Table Indicators 4-6). Index aggregation by arithmetic and geometric mean was also compared. We assessed the median absolute difference in district ranks and its inter-quartile range, testing alternative approaches to index formulation (Hogan et al., 2018). External validation of the index was conducted by exploring its relationship with indicators of public health performance and maternal health outcomes, particularly the Human Development Index (HDI) and maternal mortality rates (Bhattacharjee, 2012; Bolarinwa, 2015; Booyesen, 2002). Confidence intervals for correlations were calculated by bootstrapping methods in R v3.6.1.

Results

Performance at provincial level

In the North West province, we combined 12 indicators of access and utilization to care, two quality of care, two linkages of care and nine social determinants of health indicators to measure the C₃MH index (Table 1).

Table 1: The continuum of care for maternal health index, sub- indices and indicators for North West Province, South Africa, in the period 2013-2017.

Indicators	Targets	Indicator Performance					Indicator Scores				
		2013	2014	2015	2016	2017	2013	2014	2015	2016	2017
Cervical cancer screening coverage	100%	58%	62%	66%	66%	69%	58	62	66	66	69
Antenatal 1st visit before 20 weeks rate	100%	48%	53%	59%	64%	64%	48	53	59	64	64
Antenatal 1st visit coverage	100%	78%	79%	75%	76%	78%	78	79	75	76	78
Syphilis positive pregnant female receive Benz-penicillin 1st dose rate	100%	na	na	57%	57%	78%	na	na	57	57	78
Syphilis positive pregnant female receive Benz-penicillin 2nd dose rate	100%	na	na	60%	60%	57%	na	na	60	60	57
Syphilis positive pregnant female receive Benz-penicillin 3rd dose rate	100%	na	na	57%	57%	50%	na	na	57	57	50
Antenatal client starts on antiretroviral therapy rate	100%	63%	88%	89%	93%	93%	63	88	89	93	93
Delivery by Caesarean section rate	5-15%	18%	21%	22%	21%	24%	92	89	88	89	86
Delivery in facility rate	100%	65%	67%	69%	69%	72%	65	67	69	69	72
Mother postnatal visit within 6 days rate	80-100%	75%	76%	71%	73%	77%	85	86	81	83	87
Couple year protection rate	50-100%	42%	54%	50%	59%	55%	67	75	75	75	75
Termination of pregnancy 0-12 weeks rate	100%	97%	96%	95%	95%	96%	97	96	95	95	96
<i>Access sub-index</i>							<i>70.9</i>	<i>76.0</i>	<i>71.5</i>	<i>72.5</i>	<i>74.1</i>
Antenatal client HIV re-test rate	100%	47%	64%	78%	100%	100%	47	64	78	100	100
Average ideal clinic status (score)	70-100%	na	55%	55%	65%	66%	na	70	70	80	81
<i>Quality sub-index</i>							<i>47</i>	<i>66.9</i>	<i>73.9</i>	<i>89.4</i>	<i>90.0</i>
Emergency rural obstetric response under 40 minutes rate	75-100%	na	na	na	61%	61%	na	na	na	74	74
Emergency urban obstetric response under 15 minutes rate	75-100%	na	na	na	41%	41%	na	na	na	54	54
<i>Linkages sub-index</i>							<i>na</i>	<i>na</i>	<i>na</i>	<i>62.7</i>	<i>62.7</i>

Domestic water compliance rate	100%	72%	53%	62%	76%	63%	72	53	62	76	63
% women 15-49 who are literate	100%	83%	84%	83%	83%	82%	83	84	83	83	82
% women 15-49 in households with adequate water infrastructure	100%	82%	82%	78%	80%	80%	82	82	78	80	80
% women 15 -49 with basic sanitation facility	100%	71%	69%	70%	71%	71%	71	69	70	71	71
% women 15-49 living in adequate housing	100%	52%	44%	48%	54%	55%	52	44	48	54	55
% women 15-49 living in formal housing	100%	85%	85%	82%	82%	83%	85	84	82	82	83
% women 15-49 with access to electricity	100%	95%	95%	94%	94%	95%	95	95	94	94	95
% women 15 - 49 who have adequate food access	100%	62%	62%	62%	64%	64%	62	62	62	64	64
Mean Household Dietary Diversity Score (women 15-49) (converted to 100)	100%	62	61	62	62	62	62	61	62	62	62
<i>SDoH index score</i>							72.6	68.6	69.9	73.0	71.8
<i>CoC (maternal health) Index</i>							62.3	70.4	71.7	73.8	74.0

SDoH= social determinants of health; CoC= continuum of care.

The C₃MH index at the provincial level ranged from 62.3 in 2013 to 74 in 2017, showing a general trend of improvement (see table 1). The two sub-indices that substantially contributed to this increase were:

- *Improvement in access and utilization of care indicators*, particularly cervical cancer screening, timely antenatal care and antiretroviral drug provision.
- *Improvement in facility performance on quality of care measures*. The quality sub-index improved from 66.9 in 2014 to 90 in 2017. However, this sub-index is only based on two indicators, one of which represents a drastic improvement in HIV program processes. A gap exists in maternal health care safety and patient experience of care indicators for measurement of quality in the North West province.

Little overall improvement was made in the social determinants of health during that period, which may point to a slow pace of development in the province. Data was unavailable for the

period (2013-14) to monitor treatment of sexually transmitted illness (syphilis), emergency obstetric transport (2013-2015), and quality of care (Ideal Clinic) (2013-2014).

Monitoring performance at district level

There was an overall improvement in the index at district level over the period 2013-2017, as illustrated in Fig 3.

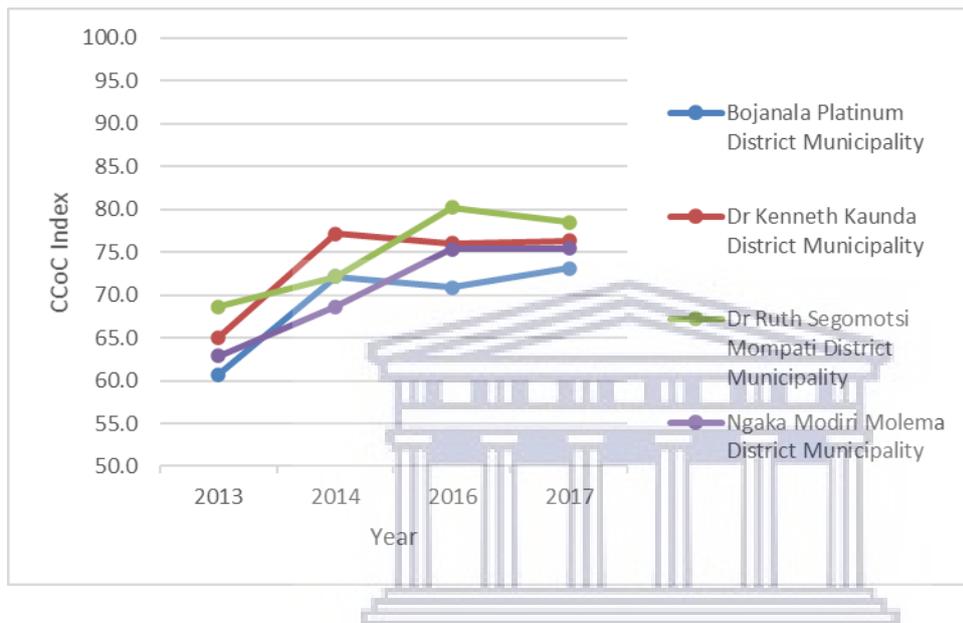


Fig 3 Comprehensive continuum of care index (C3MHindex) scores by districts over a five-year period 2013- 2017

Overall, Dr Ruth Segomotsi Mompoti (RSM) district performed better than other districts on the index, while Bojanala Platinum performed generally poorer. We also compared sub-index performance to demonstrate effect on overall scores, using 2016 as a reference year (Fig 4).

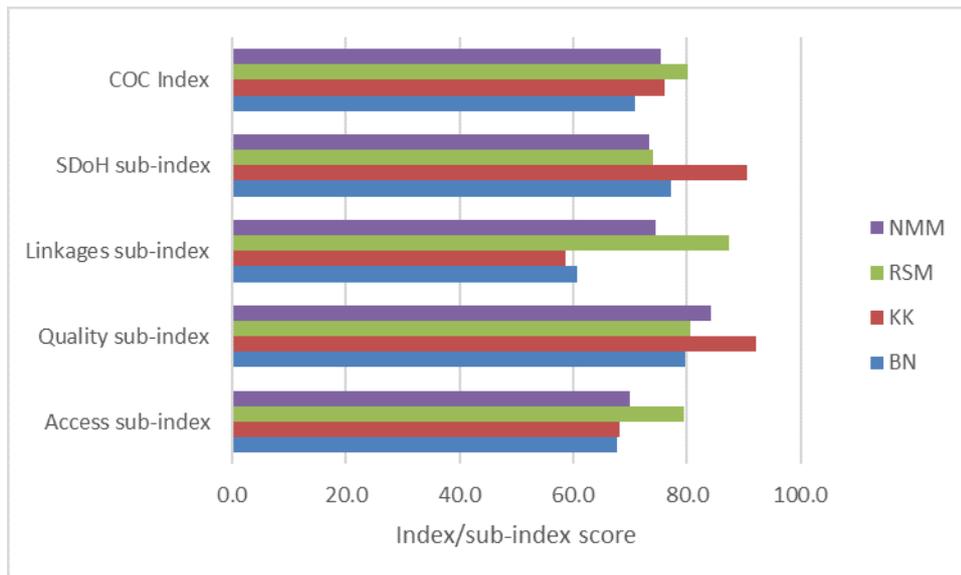


Fig 4 Sub-index and C₃MH index scores by districts in 2016. BN = Bojanala Platinum District, KK = Dr Kenneth Kaunda District Municipality, RSM = Dr Ruth Segomotsi Mompati District Municipality, NMM = Ngaka Modiri Molema District Municipality, SDOH = Social determinants of health.

In 2016, Dr Kenneth Kaunda district scored relatively higher than other districts on the social determinants of health and quality of care sub-indices. However, due to poor performance on access and linkages of care, the district scored second best in overall performance in 2016. Comparatively, the Ruth Segomotsi Mompati district had relatively high scores across sub-indices and thus ranked highest in 2016. Thus, the balance of good performance across all sub-indices improved the overall index.

Robustness

There was no significant difference in district ranks between index scores calculated with linearly scaled indicators (our method) and z-score standardization ($r_s=0.83$, 95% CI = (0.49-0.95)) (Table 2). There was also no significant difference between index scores when geometric and arithmetic aggregation techniques were used ($r_s=0.95$, 95% CI= (0.78-0.99)). The median absolute difference in index rankings at district level when linear and z-score standardization were compared was two ranks with an interquartile range (IQR) of 0-3. There was no difference

in rankings (IQR= 0-1) observed at district level when indices computed with arithmetic and geometric means were compared.

Table 2: Spearman rank correlation between alternatives for indicator standardization and aggregation at district level

	Base case	z-score (districts)	arithmetic mean
Base case	1.00		
z-score	0.83	1.00	
arithmetic mean (d)	0.95	0.84	1.00

Base case is based on linear scaling (our method) and geometric mean aggregation.

All the index values across alternative indicator selections were highly correlated (Table 3).

Table 3: Spearman rank correlation coefficients of index values when dropping one indicator at a time to compute index

	Base case (all)	No syphilis 2&3	No termination	No syphilis & no termination
Base case (all)	1.00			
No syphilis 2&3	0.98	1.00		
No termination	0.99	0.97	1.00	
No syphilis & no termination	0.98	0.99	0.98	1.00

Validation

The C₃MH index had a positive correlation ($r=0.972$, 95% CI = (0.63, 0.99)) with the Human Development Index (HDI) in the North West province for the period 2013-2017. The HDI measures healthy life outcomes, education and standard of living (United Nations Development Program, 2016). The index also increased with decreasing rates of institutional maternal mortality at the provincial level ($r_s = -0.90$, 90% CI = (-1.00, -0.25)). The correlation between the index and iMMR at district level, was not statistically significant ($r = -0.13$, 95% CI = (-0.58, 0.39)). There are no data for HDI scores at district level to allow comparisons with the COC index.

Results of multivariate analysis

Parallel analysis in exploratory factor analysis suggested one main underlying factor for the data (Fig 5), although a three-factor model may be possible.

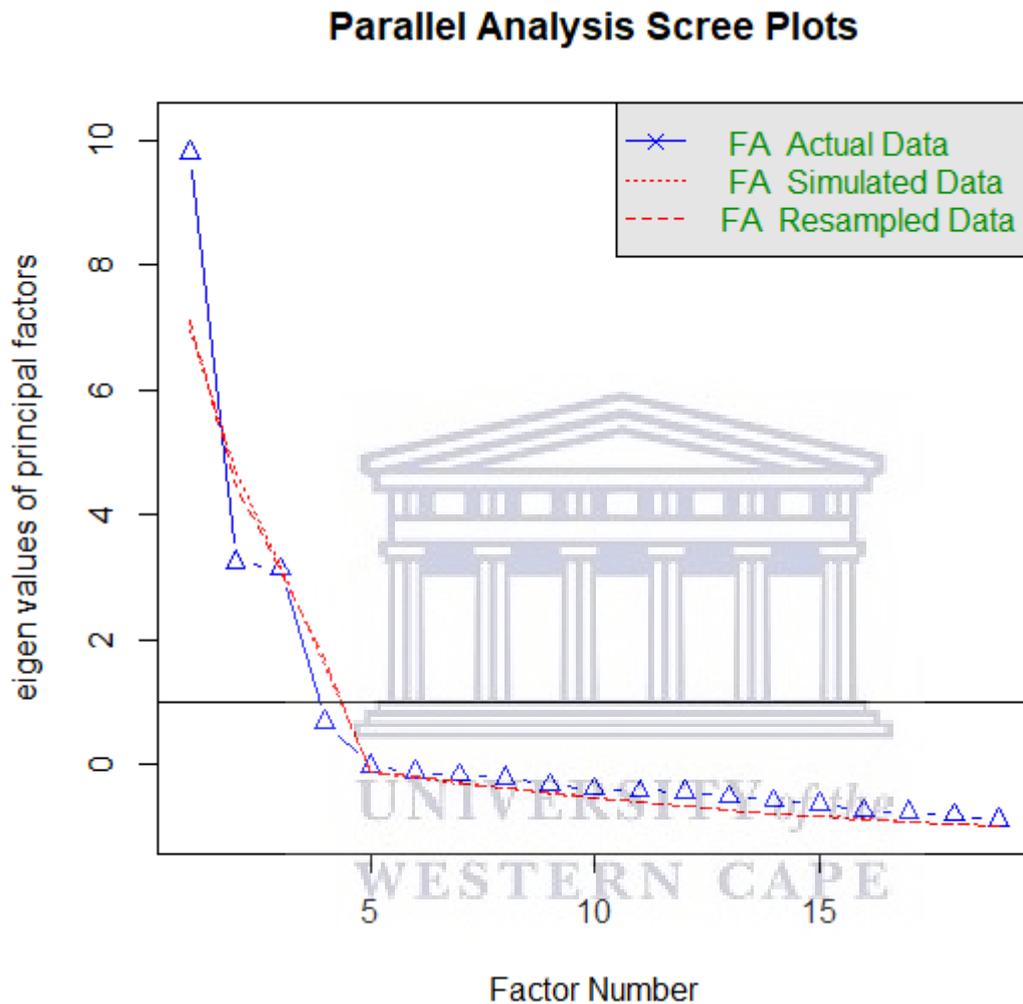


Fig 5 Parallel analysis scree plot for indicators of the continuum of care for maternal health in North West province South Africa

A one-factor model accounted for 0.52 proportion of variance of the data. A three-factor model accounted for cumulative variance of >0.9 : the majority of factor 1 indicators related to the health system or facility based care, factor 2 contained both health system and social determinants of health and factor 3 contained social determinants (Table 4). A two-factor

model accounted for 0.72 cumulative proportion of variance of the data but did not reveal any informative conceptual groupings – all factor loadings were relatively high for one factor. The variables for linkages of care and one variable for quality of care were also not included in the results of the model due to missing data.

Table 4: Exploratory factor analysis of the items of the continuum of care service delivery framework

	Factor 1	Factor 2	Factor 3
Cervical screening	0.93	-0.25	0.20
Timely antenatal visit	0.90	-0.33	0.31
ARTs during antenatal care	0.95	-0.25	-0.21
Caesarean section delivery	0.91	-0.08	-0.02
Delivery in facility	0.91	-0.12	0.25
Couple year protection rate	0.86	-0.09	-0.05
HIV retest rate	0.91	-0.24	0.33
Adequate food	0.77	0.14	0.47
Ante natal care coverage	-0.06	0.99	-0.14
Postnatal visit	0.18	0.98	0.06
Timely pregnancy termination	-0.59	0.75	0.15
Water infrastructure	-0.45	0.83	-0.13
Type of housing	-0.52	0.78	-0.35
Electricity access	-0.33	0.91	-0.23
Water safety compliance	-0.23	-0.26	0.79
Literacy	-0.37	0.02	-0.77
Sanitation	0.20	0.08	0.98
Housing condition	0.25	0.01	0.97
Household dietary diversity	-0.04	-0.45	0.86

Notes: Extraction method – ordinary least squared/minres; Rotation – varimax; Loading larger than 0.5 are in bold.

Discussion

This study demonstrated the development and testing of a comprehensive and multidimensional index to assess the continuum of care for maternal health at sub-national levels in SA. The C₃MH index measured health and non-health sector components of service delivery for maternal health, as guided by the continuum of care framework for SA (Bradshaw

et al., 2008). The multi-sectoral perspective of the index is increasingly important in current public health and health system performance assessment (Begg et al., 2018; Department of Health, 2012e; Maina et al., 2017). The index was comprehensive in that it allowed monitoring of myriad interventions, summarized through four sub- indices representing dimensions of the continuum of care. The comprehensive and multisectoral character of the index contrasts with the “silo” or vertical program approach that singles out single interventions to address maternal health outcomes (Horwood et al., 2010).

Our findings suggest that the index can be used as a monitoring tool to compare sub-national performance over time and as a basis for recommendations on areas of service delivery improvement. For instance, our findings show that improvements in access and linkages to care will enhance Dr Kenneth Kaunda district’s overall score and improve its ranking. On the other hand, in Dr Ruth Segomotsi Mompati district, poor performance on the social determinants of health affected the index. Thus, while the C₃MH index can be used to compare and rank districts, an analysis of sub- indices indicates areas that may proportionally affect overall performance. The relevance and utility of sub-components of composite indices for public health policy and action is important to consider as well, beyond the monitoring application of the overall index (Barclay et al., 2019; Profit et al., 2010).

Our findings also indicate that the index was robust and not much influenced by outlying scores for specific indicators. In other words, the index values the parts differently than the whole, as well as good performance over several indicators and not just a few outlying values. Further research is needed to compare the index to other comprehensive standards for the integrated care approach it seems to reflect. Alternative methods for computing the index and standardising the indicators produced comparable results. The simple geometric approach allows future integration of missing data, while maintaining the conceptual grounding of the

index. Our approach also accommodates the expected refinements of indicators over time (Department of Health, 2016); the index should undergo recurrent assessment and validation to remain useful (Benova et al., 2019). Additionally, exploratory factor analysis indicates a distinction between at least two factors, with one factor covering health systems indicators and the other factor(s), social determinants of health. This reflects the multidimensional nature of the index and underlines the need to include social determinants as a dimension of continuum of care in maternal health.

Limitations

This was a case study of five sub-national geographical areas over a five-year period. We recommend more research across other provinces/districts to allow further comparison. In other countries, the same approach using a comprehensive set of available indicators can be used to develop a contextualised version of the index. The composition of the index in this study was affected by gaps in data availability common in the SA health system (English et al., 2011). We recommend health information system improvements in monitoring and availability of data so that better estimates of the index can be made in the future. In addition, the lack of comparability of provincial and district level associations between the index and maternal outcomes warrants further investigation. There may be systemic issues with maternal mortality estimation in the country (Damian et al., 2019) and we also recommend use of the GHS as a source of data at district level. Other indicators could also be considered as proxies based on their shown reciprocity with maternal health indicators, such as neonatal and child health outcomes (Boerma et al., 2008; Dettrick et al., 2016; Wehrmeister et al., 2016; Wilunda et al., 2015).

Conclusion

This study shows the feasibility to monitor and assess service delivery for the continuum of care for maternal health using indicators from different sectors with a composite index. The index allows monitoring of performance over time and across geographical areas. From our analyses, we concluded the index to be robust and valid, with potential to guide policy and planning to improve maternal health outcomes and service delivery from a multisectoral perspective. More comprehensive monitoring of social determinants at district level and health information system strengthening can further improve and extend the use of this index. The index is amenable for testing with data from different South African and international contexts.

Acknowledgements

References

(please see [references](#) section)

Supporting Information

[S1 Table. Indicators used for measurement of the continuum of care index in North West province and districts 2013-2017](#)

Figures and Tables

(in text)



Chapter 7 – Development of the Analytical Framework

Chapter 7 has been submitted as an analytical piece titled “An analytical framework based on the adequacy of the continuum of care for maternal health in low- and middle-income countries: findings from mixed-methods research” Author(s): Mamothena Mothupi, Lucia Knight. *Family Medicine and Community Health* (submitted November 2020).

This chapter presents the synthesis of the analytical framework for measurement and monitoring of the CoC for maternal health in LMICs, based on the findings in Chapters 3-6 in both LMIC and the South African context. The analytical framework was developed as a result of the integration of findings through a triangulation protocol and analysis of themes related to a new research question. The research question is focused on development of a standard approach for measurement and monitoring of the CoC that can be applied across all LMICs. In the standard approach, specific indicators for monitoring interventions on the continuum will be context specific, while the adequacy construct and the four dimensional- C₃MH index remain the same. The analytical framework thus functions as a guide with multiple steps and considerations for application and evaluation of the measurement approach proposed in this research in other contexts within and outside of South Africa. It highlights the importance of all the studies from Chapters 3-6 in providing a holistic understanding of measurement and monitoring of the CoC for maternal health.

An analytical framework based on the adequacy of the continuum of care for maternal health in low- and middle-income countries: findings from mixed-methods research

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Abstract

The provision of health services across the continuum of care for maternal health is important to improve access to services and health outcomes. However, the continuum of care framework is currently not adequately applied to health service improvements in low and middle income countries (LMICs). One of the gaps in application is the lack of comprehensive measurement and monitoring of the continuum of care, which can allow countries to track and improve system performance. This analysis describes an analytical framework for measurement and monitoring of continuum of care in LMICs, based on original mixed methods research in South Africa and other LMICs. The proposed framework is shown to support monitoring and evaluation at subnational and national levels, introducing an approach that meaningfully integrates the social determinants of health, health service provision, quality of and linkages to maternal health care.

Summary Box

- The current literature shows that measurement and monitoring of the continuum of care for maternal health is not comprehensive enough, focusing primarily on antenatal, delivery and postnatal care.
- A comprehensive approach will include multiple dimensions, encompassing not just access and utilization of services but quality of care, linkages to care and social determinants of health.
- An analytical framework is proposed that includes a conceptual model of adequacy of the continuum of care, a broad set of indicators and a four-dimensional composite index (the C₃MH index) to measure performance across time and geographical locations.

- The proposed indicators and C₃MH index can be used to track performance at the subnational level within an LMIC; the latter summarizes performance for potential inclusion of a broader set of indicators in national and global monitoring and evaluation frameworks.

Introduction

The continuum of care for maternal health encompasses the provision of health and other public services from preconception through to the postnatal period to ensure good health outcomes and improved access to care (Bradshaw et al., 2008; de Graft-Johnson et al., 2006; Kerber et al., 2007a; PMNCH, 2011). The main principle of the continuum of care is to ensure service availability at the right time and the right place, while ensuring good quality of care (Graham & Varghese, 2012; Nesbitt et al., 2013). Research in low and middle income countries (LMICs) has demonstrated the positive impact of the use of the continuum of care framework (Kikuchi, et al., 2015; Okawa et al., 2019; Wang & Hong, 2015; Yeji et al., 2015), and health systems are increasingly integrating it into strategic documents to improve maternal health outcomes (NCCEMD & Department of Health, 2016; Department of Health, 2012, 2015).

There are still gaps in proper implementation of the continuum of care framework in LMICs, precipitated by the lack of a standard measurement and monitoring approach to ensure service delivery and accountability. National and cross-country studies use only a handful of continuum of care indicators to assess its implementation and impact (Abegunde, Orobato, Shoreire, et al., 2015; Barros & Victora, 2013; Boerma et al., 2008, 2018; Kumar et al., 2013). The continuum of care is a comprehensive and multifaceted framework, which prescribes broad maternal health interventions and highlights other cross-cutting factors/social determinants of

health (Bradshaw et al., 2008; Kerber et al., 2007a) (Figure 1). There is also a lack of a uniform approach for measurement and monitoring of the continuum of care across current studies, as a previously conducted systematic review found (Mothupi et al., 2018). This lack of a uniform approach leads to limited application to policy and practice, creating a missed opportunity for service improvements and multisectoral collaboration.

Figure 1. The continuum of care framework for maternal and child health in low- and middle-income countries (Source: Kerber et al., 2007)

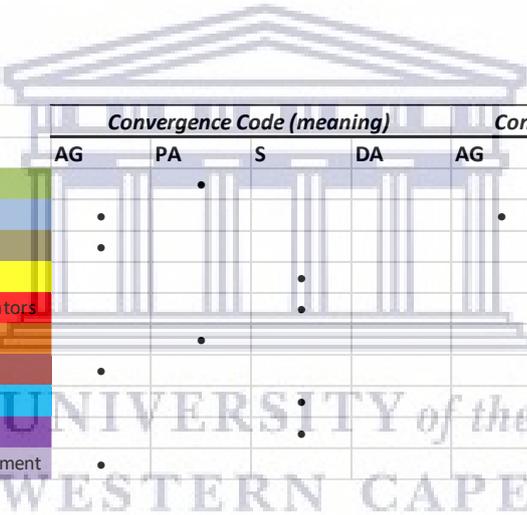
We previously conducted mixed methods research to measure and monitor the continuum of care at the subnational level within an LMIC context, in South Africa. The quantitative elements of the research explored indicators and composite metrics for the measurement and monitoring of the continuum of care (Mothupi, de Man, et al., 2020; Mothupi, Knight, et al., 2020). The qualitative research evaluated the proposed metrics and implications for interpretation and implementation of continuum of care measurement and monitoring (Mothupi et al., 2018; Mothupi et al., 2019). Although the conceptual elements of the research were applicable across contexts, the quantitative findings were applicable only to the South African context. In this analytical paper, we collate the findings of this mixed methods research and offer second-order interpretations of its meaning for other LMICs.

Triangulation approach

We relied on a triangulation protocol to ascertain the complementarity of the meaning of findings across the mixed methods studies. Triangulation protocols are operational tools used to create meaning out of qualitative studies (Farmer et al., 2006), as well as to integrate qualitative and quantitative research (Hind 2020; O’Cathain et al., 2010). The analytical question for our triangulation was: *How can the continuum of care for maternal health be measured, monitored, and assessed in LMICs?* The analysis thus identifies important factors

as proposed by the original studies, and other literature is also incorporated to enable a critical analysis of the proposed analytical framework. The use of the triangulation protocol allows for transparency in terms of how original findings contribute to this analysis.

The findings of the triangulation protocol in terms of important themes or factors for continuum of care measurement, monitoring and assessment in LMICs are summarized in Table 1 (appendix). Table 1 is a convergence analysis of 10 key themes emerging from the original studies, which include conceptual modelling; development and selection of indicators; composite indexing; and analysis of feasibility, relevance, and validity of measures. The convergence coding matrix in Figure 2 summarizes the relationships of the themes across the studies.



Theme	Convergence Code (meaning)				Convergence Code (prominence)			
	AG	PA	S	DA	AG	PA	S	DA
Conceptual model			•					•
Selection and description of indicators	•				•			
Composite indexing	•					•		
Performance tracking				•			•	
Describe the utility framework and indicators				•			•	
Assessment of measurement gaps		•				•		
Assessment of validity	•					•		
Feasibility considerations				•			•	
Relevance considerations				•			•	
Describe systemic challenges to measurement	•							•

Figure 2 Convergence coding matrix of findings on the meaning and prominence of key themes (factors) for assessing the continuum of care. Agreement (AG), partial agreement (PA), silence (S) and dissonance (DA)

There was a high degree of partial agreement and agreement of theme meaning and prominence across studies, with silence produced when study design and methodology does not allow exploration of a specific theme. For instance, description of performance can only be done with quantitative data and methods while interpretation of their relevance is best done with qualitative methods. Dissonance was created when there was a difference in the use of a theme

across studies, although it did not negate complementarity. For instance, the conceptual model for continuum of care measurement and monitoring was not a prominent theme in some studies while it formed the basis of others (those describing the composite index formulation process).

The adequacy construct and the comprehensive composite index

One of the themes identified by the triangulation protocol was the importance of a conceptual model for measurement and monitoring of the continuum of care. While the continuum of care framework outlines important interventions at all levels of care, the monitoring of these usually depends on the data available to researchers and practitioners (Mothupi et al., 2018). This creates an analytical approach that may not be comparable across contexts, which impedes monitoring of the continuum of care to ensure comprehensive service delivery. In addition, interventions implemented for the continuum of care depend on the epidemiological profile of the country as well as resources available (Bradshaw et al., 2008; Kerber et al., 2007a). Thus, the monitoring approach in any given context may reflect only what is feasible and not necessarily what *should* be implemented. As public health challenges and policy evolves, the specific interventions outlined in the continuum of care framework may also change. Experts interviewed to evaluate the indicator set for South Africa echoed this notion (Mothupi, Knight, et al., 2020).

The conceptual model proposed by the previous analyses is called the adequacy of the continuum of care construct and is defined thus:

Measurement of timely access to evidence based interventions encompassed by the continuum of care service provision framework for maternal and child health, through a positive experience of care and within a supportive structural context that ensures

good quality of care (i.e. competent human resources, actionable information systems, functional referral systems and essential physical resources) (Mothupi et al., 2018).

The application of the adequacy construct means that comprehensive health and non-health sector interventions, at community and health system level, are important to monitor (Bradshaw et al., 2008; de Graft-Johnson et al., 2006; Kerber et al., 2007). As are elements of multidimensional quality of care (Tunçalp et al., 2015) and linkages between care levels and packages of interventions (Bradshaw et al., 2008; Kerber et al., 2007). The adequacy construct integrates service provision and quality of care frameworks together as a basis for a uniform, conceptually grounded approach to continuum of care monitoring. As a construct emerging from the systematic review of current measurement and monitoring approaches, it also addresses some of the gaps in the current literature (Mothupi et al., 2018). These gaps relate to the lack of comprehensiveness and multidimensionality of indicators used to monitor the continuum of care.

The use of the adequacy construct as the basic conceptual model of the continuum of care transcends the specific indicators being used to monitor interventions, but instead emphasizes their dimensions. In the indicator selection study for South Africa, we showed how the availability of a large number of indicators (38) still resulted in measurement gaps (Mothupi, Knight, et al., 2020). We used the adequacy construct to demonstrate dimensions of the continuum of care that still need to be measured, beyond individual interventions alone. The study identified a lack of measurement of the quality of care and linkages to care indicators, primary factors related to maternal health outcomes in South Africa and indeed other LMICs (NCCEMD, 2014; NCCEMD & Department of Health, 2016; Kruk et al., 2018; Pillay & Barron, 2018). Thus, the adequacy construct helped us assess the *types* of indicators needed to improve the monitoring of maternal health in LMIC contexts.

The adequacy construct also served as the conceptual basis for the formulation of a composite index to summarize indicators across the continuum of care (Mothupi, de Man, et al., 2020). Composite indexing helps to create easy metrics to use in policy and action when a concept is represented by diverse indicators. An index has to be conceptually grounded in order to be robust to indicator changes over time and allow uniform interpretation across contexts (Booyesen, 2002b; OECD, 2008). The four-dimensional measurement model for continuum of care composite indexing, based on the adequacy construct is illustrated in Figure 3.



Figure 3: The four-dimensional model for assessment of an adequate continuum of care for maternal health

The model in Figure 3 guided the dimensions of measurement included in the comprehensive continuum of care for maternal health index (C₃MH index), which was developed to summarize the diversity of indicators along the continuum of care and enabled

tracking of performance over time (Mothupi, de Man, et al., 2020). The C₃MH index was developed as a geometric mean of the four dimensions of the model Figure 3:

$$C_3MH \text{ index} = (\text{Access to care} \cdot \text{Linkages} \cdot \text{Quality of Care} \cdot \text{Social Determinants of Health})^{1/4}$$

(Mothupi, de Man, et al., 2020)

The C₃MH index was used to track performance over time and across subnational contexts (district and province) in South Africa (Mothupi, de Man, et al., 2020), but has not been tested in other LMICs. When applied to other contexts, the indicators that constitute each dimension may differ slightly, although there may be some similarities if countries use standard guidelines from the WHO and other scientific literature (Flenady et al., 2016; Moller et al., 2018; Moran et al., 2016; Saturno-Hernández et al., 2019). The use of the District Health Information System (DHIS) for routine facility information in many LMICs also means that there will be similarities across indicators, at least for basic interventions (Akhlaq et al., 2016; WHO, 2016). Countries also implement standard living conditions surveys that capture the social determinants of health, such as the Demographic and Health Survey (Arsenault et al., 2018; Deribew et al., 2016; Footman et al., 2015). The comparability of the index across national contexts thus needs to be well interrogated in future research, while it lends itself to current application across subnational geographical areas.

Interpretation and integration of continuum of care indicators and index

The themes identified in Figure 2 also highlight important qualitative findings that have implications for interpretation of continuum of care performance as measured through indicators and the composite index. In key informant interviews with potential users of the proposed monitoring indicators, we found the perception that both the continuum of care framework and proposed indicators could be useful for aiding future multisectoral

collaboration in maternal health (Mothupi et al., 2019). This could potentially represent a shift in perspective from a health facility-oriented continuum to integration of community components and the performance of other sectors. Improvements in measuring and monitoring intersectoral action were recommended, where multiple sectors may be co-accountable for indicator performance. Currently, there are gaps in monitoring intersectoral action in maternal health, as well as other gaps and systemic challenges to performance measurement and tracking.

The tracking of indicator performance for the 2013-2017 period in the North West province revealed reporting incompleteness and data quality issues from the health information system that impacted computation of the composite index (Mothupi, de Man, et al., 2020). These systemic issues in data quality and reporting are common across LMICs, and negatively impact the monitoring and evaluation of system performance (Mutale et al., 2013; Sheikh, 2014). The South African district health information system needs to be improved in terms of data quality, timeliness, integration of private sector data, and patient-centredness, among others (Malakoane et al., 2020; Mayosi et al., 2012; Mphatswe et al., 2012). Thus, when the analytical framework is applied in other LMIC contexts, it will be important for researchers and practitioners to reflect on the systemic challenges to data collection and reporting and how they impact monitoring of interventions.

Holistic interpretation of the continuum of care necessitates alignment with the critical realist perspective that phenomenon such as the continuum of care have underlying structures or mechanisms that are not always explained by empirical evidence (Alvesson & Skoldberg, 2009; Zachariadis, Scott, & Barrett, 2013a). Therefore, for the analytical framework of the continuum of care, it was important to qualitatively evaluate the proposed indicators even when a lot of data was available. Recommendations were then made to add or alter indicators to

better reflect interventions and ultimately improve the evidence base for decision-making (Mothupi et al., 2019; Mothupi, Knight, et al., 2020). A similar approach can be adopted in other LMICs.

All interventions on the continuum, not just ‘key interventions’, contribute to maternal mortality and should be monitored comprehensively and in a feasible manner. Our systematic review showed that measurement of the continuum of care at global and national levels did not fully reflect intervention at the subnational levels, filtering only a handful of indicators for policy and action (Mothupi et al., 2018). In South Africa, the indicators in the national frameworks and policy documents only reflect a subset of interventions relevant to the continuum of care for maternal health (Department of Health, 2012e). For example, the ‘key indicators’ for maternal health were maternal mortality, access to contraceptives, antenatal care attendance, prevention of mother-to-child transmission of HIV and skilled birth attendance in the national Strategic Plan for Maternal, Newborn, Child and Women’s Health and Nutrition 2012-2016 (Department of Health, 2012e). In the annual plan and the national indicator dataset a broader set of indicators is highlighted, including cervical cancer screening, post abortion services and quality of care during caesarean sections (Department of Health, 2018a, 2019). By adopting a broad perspective, these indicators can, using tools such as the C₃MH index, be tracked at all levels. The subnational level remains key, as it is the focus of health sector reforms to reduce inequalities and solve complex contextual problems (Hulton et al., 2014; Hunter et al., 2017; Maina et al., 2017; Schneider et al., 2014). The primary level of care is also relevant in terms of universal health coverage and the mandate to provide comprehensive health services (Ataguba et al., 2014; Barasa et al., 2018; De Andrade et al., 2015).

Limitations and future research

There are some limitations in the current proposed analytical framework, which necessitate more research, to integrate additional aspects, and test it in different contexts. One of the limitations is a lack of similar analysis for child health. We assessed only maternal health to demonstrate the development and testing of the analytical framework, and future research could explore similar methods for child health, and for both maternal and child health. In addition, the tools proposed for the analysis in South Africa should, continually be evaluated and strengthened, to better measure and monitor the continuum of care. This includes participatory research to determine and evaluate indicators and their targets in South Africa and other LMICs. The use of participatory methods may enable consensus on the selection of measures for use in monitoring the continuum of care and thus improving their utility to policy and action. The analytical framework also needs to be validated as a whole, not just aspects of it through the individual studies. Finally, some of the original findings need further validation, although a systematic review synthesized current measurement approaches in LMICs, more research about the composite index to validate it, in different contexts within and outside of South Africa, would be an important contribution.

Conclusion

The analytical framework for the continuum of care describes how the latter can be measured and monitored within a subnational context in South Africa, with some applicability to other LMICs. It is based on a mixed method research study that over the course of a series of papers, triangulated here, have developed the conceptual model, proposed indicators, derived the composite index and evaluated utility for policy and action within a South African context. The conceptual model or construct of adequacy of the continuum of care and the four-dimensional composite index, the C₃MH index, are also applicable to other LMIC contexts.

The C₃MH index can be tested with local indicators and used to compare health system performance over time and geographical areas at the subnational level. This is useful for the comprehensive monitoring of maternal health at the primary care level, where negative outcomes can be prevented.

LIST OF ABBREVIATIONS

Please see the [Acronyms/Abbreviations](#) section

REFERENCES

Please see [References](#) section

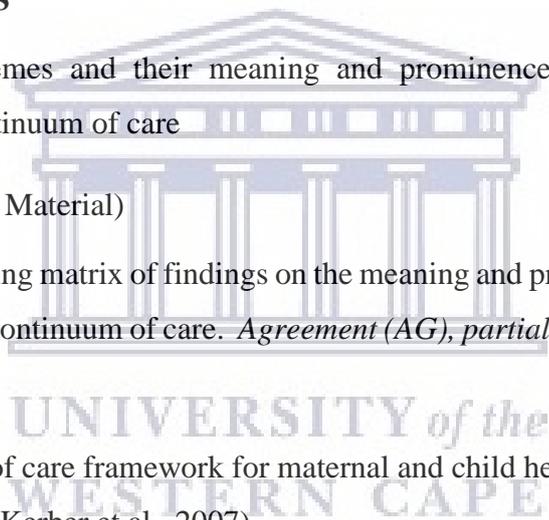
TABLES AND FIGURES

Table 1. Analysis of themes and their meaning and prominence across qualitative and quantitative studies of continuum of care

(please see Supplementary Material)

Table 2. Convergence coding matrix of findings on the meaning and prominence of key themes (factors) for assessing the continuum of care. *Agreement (AG), partial agreement (PA), silence (S) and dissonance (DA).*

Figure 1. The continuum of care framework for maternal and child health in low- and middle-income countries (Source: Kerber et al., 2007)



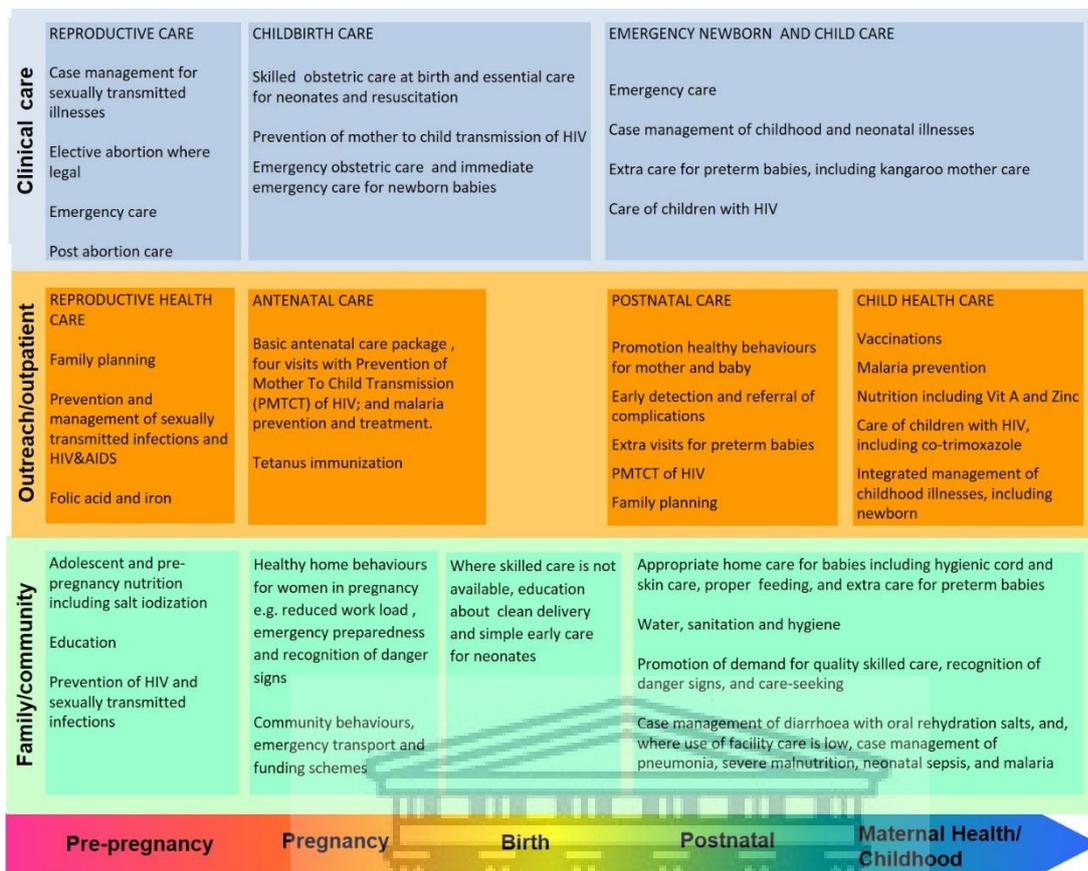


Figure 1 legend: The continuum of care framework for low- and middle-income countries was derived from a review and synthesis by Kerber et al. (2007). The framework shows important public health interventions for maternal (as well as child) health from the pre-pregnancy to the postnatal period. It also shows the health system levels of care on the vertical axis. The important health system levels are the family/community level, outreach and outpatient level (such as community health centres), and clinical care in primary health facilities. It is thus essentially a district-oriented framework. The family and community level represents interventions for which both the health system and other sectors are responsible, such as water and sanitation and education.

Figure 2: The four-dimensional model for assessment of an adequate continuum of care for maternal health

Figure 2 legend. The model conceptually groups indicators for interventions across the continuum of care into whether they address quality of care, social determinants of health, access and utilization of care and linkages to care. Using the model helps to take analysis beyond the number of indicators available across interventions, to a consideration of how well they capture the multidimensional aspects of the continuum of care. Quality of care can be measured in terms of signal functions and observations, as well as readiness assessment that capture provision of services and patient experience of care. Linkages to care represent interventions that facilitate access to care from one level of the system to another (such as transport and referrals), and between one intervention package (e.g. antenatal care in general) to another (e.g. delivery in facility or emergency obstetric care). Access and utilization of care represents key interventions such as antenatal visits, delivery in facility and postnatal visits which may indicate coverage but not quality of services. And social determinants of health are based on behaviours and services that are cross-cutting at the family and community level of the continuum of care and can be promoted and delivered by the health system and/or other sectors.



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COMPETING INTERESTS

The authors declare that they have no competing interests.

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AUTHORS' CONTRIBUTIONS

Mamothena Mothupi conceptualized the study, conducted the analysis, and wrote the manuscript. Lucia Knight contributed to the analysis and writing of the manuscript. All authors read and approved the final version manuscript.



Chapter 8 - Discussion and Conclusion

Chapter 8 presents the discussion of findings and conclusions of this research by expanding on the ideas integrated in Chapter 7 and the original findings in Chapters 3-6. Chapter 8 is structured according to the objectives of this research as presented in Chapter 1 and discusses its main contributions to public health research and practice. In addition, the link between the findings and the theoretical and methodological approach adopted in this research are discussed. The research objectives focused, in summary, on developing a conceptual model (Chapter 3); proposing indicators and a composite index for measurement and monitoring of performance on the continuum of care (CoC) (Chapters 4 and 6); assessing experts' perspective on the CoC framework and proposed indicators for the South African context (Chapter 5); and proposing a unifying analytical framework that integrated all original findings (Chapter 7).

8.1 Proposing a conceptual model for CoC

The field of CoC measurement and monitoring in maternal (and child) health is growing, with studies describing access and associated factors in different LMIC contexts since the early 2010s. However, studies have adopted different approaches for describing performance on the continuum, without a clear conceptual model guiding the choices of indicators and interpretation of measurements gaps. This study established the *adequacy* construct to serve as the conceptual model to assess the CoC in South Africa and other LMICs (Chapter 3 and 7). Using the adequacy model, several aspects of an effective continuum of care can be integrated into one: these are quality of care, linkages of care, social determinants of health, and access and utilization of health services.

Some of the areas integrated by the adequacy model are well studied and guide the selection and evaluation of relevant indicators. For example, this research proposed the use of the WHO

Framework for Quality of Care for maternal and newborn health (Brizuela et al., 2019; Tunçalp et al., 2015) and the Ideal Clinic Realization and Maintenance Program in South Africa (Department of Health, 2018b; Hunter et al., 2017) to guide indicators of multidimensional quality of care at the facility level. For application to other LMICs, data on quality assessments in health facilities, which reflects both readiness, observation of signal functions, and experience of care by mothers can be used. This study also demonstrated the integration of social determinants of health by identifying relevant indicators across non-health sectors (Chapter 4). Like quality of care, the indicators for social determinants of health were evidence-based, guided by existing conceptual frameworks of health determinants (Chapter 4).

The adequacy model highlighted the importance of timeliness of care, an important factor in maternal health outcomes in LMICs. Timeliness allows early and preventive care to mitigate negative outcomes and is a common factor in maternal health determinant frameworks (de Graft-Johnson et al., 2006; Mwaniki et al., 2016; Pacagnella et al., 2012; Thaddeus & Maine, 1994). Literature from South Africa and other LMICs showed that delayed care seeking and care provision increased complications and risk of death among mothers (NCCEMD, 2014; NCCEMD, 2016; November & Sandall, 2018). This study identified indicators with aspects of timeliness embedded in them, particularly those related to care seeking for antenatal and postnatal care (Chapters 4 and 6). However, this study also identified gaps and made recommendations for monitoring of timely care across the continuum, including during birth and referrals to the next level of care.

8.2 Proposing indicators for a comprehensive CoC

There were 39 indicators from the health information system and household surveys identified to monitor the comprehensive CoC for maternal health in South Africa (Chapter 4). These

indicators are currently in use for policy and programs in the country (Department of Health, 2019a; Statistics South Africa, 2017a) and were thus repurposed in this research. The use of repurposed indicators is a reliable approach for gaining further insights from existing data and reducing data collection and reporting burdens (Bonde et al., 2019; Meystre et al., 2017; Schaller et al., 2018; Schutijser et al., 2020). It also helped to demonstrate the use of the adequacy model to categorize the broad set of existing indicators (Chapter 4). A similar approach can be conducted in other LMICs, where available indicators are reviewed systematically and evaluated for their suitability to the CoC framework.

Beyond the available indicators, this study also recommended additional indicators where gaps were observed, based on theoretical perspectives of maternal health determinants, evidence from original studies and findings from interviews with experts (Chapters 1, 4 and 5). When each intervention on the CoC is measured adequately, it is expected that the indicator set proposed for the South African context would be even broader. From the findings in Chapters 4 and 6, it was observed that the dimensions or domains of linkages of care, quality of care, and social determinants of health in particular will need to be broadened. According to experts, the available indicators however do serve as sufficient proxies for the key interventions across these domains: linkages of care reflected by access to timely emergency obstetric transport; quality of care reflected in multidimensional facility readiness measures and signal functions for prevention of mother-to-child transmission of HIV; social determinants of health represented by housing, water and sanitation, education, nutrition and empowerment indicators (Chapter 4).

The existing proxies for interventions along the CoC have been shown to have an impact on maternal health outcomes. For instance, the ability to access facilities through emergency transportation has been identified as an important determinant of maternal health outcomes in

South Africa and other LMICs (Anto-Ocrah et al., 2020; Merali et al., 2014; Mucunguzi et al., 2014; NCCEMD, 2014; NCCEMD, 2016; Oguntunde et al., 2018; Onono et al., 2019). It is also an important factor in the care delay model for maternal emergencies and is considered a distal determinant of maternal mortality (Calvello et al., 2015). The available quality of care indicators from the national indicator data set in South Africa reflected signal functions in the priority program to lower maternal mortality caused by HIV infection in South Africa (Chapter 4 and 6). Although HIV is an important determinant of maternal health in South Africa (Bomela, 2020; Chweneyagae et al., 2012; Mnyani et al., 2017; Moran & Moodley, 2012), this study recommended that other important aspects of quality such as experience of care and adherence to protocols across the continuum be equally monitored.

8.3 Experts' perspectives of the CoC framework and indicators

Each LMIC has unique challenges regarding health system interventions and public health needs, which need to be reflected in the framework and indicators for the CoC. This study used the voice of experts, who are policy and decision-makers in health and other relevant sectors, to uncover the contextual factors related to the South African context (Chapter 5). The voice of experts complemented literature and other guidelines used in this study to identify gaps and implementation issues for CoC in South Africa. One of the pivotal contributions of the expert interviews was the articulation of the multisectoral and intersectoral nature of the CoC framework, and its implication for future implementation, measurement and monitoring (Chapter 5). A multisectoral perspective of the CoC may foster co-accountability for outcomes across sectors and promote action to improve health outcomes (Blas, Roebbel, et al., 2016; Oelke et al., 2016; Rasanathan et al., 2015, 2017; von Schrinding, 2002). There are indeed multisectoral monitoring and evaluation frameworks in South Africa to which the CoC can be relevant, and they are discussed in further detail in sub-section 8.5 of this chapter.

8.4 Development and testing of a composite index

To integrate the broad set of indicators and provide a useful metric for tracking performance over time and across places, a composite index was proposed (Chapter 6). Composite indices are useful in summarizing performance across a number of indicators and aid easy interpretations for policy and planning (Barclay et al., 2019; Booysen, 2002a; OECD, 2008). The composite index proposed in this study is called the *comprehensive CoC for maternal health index (C₃MH index)* and was used to track CoC performance for the period 2013-2017 in the North West province (Chapter 6).

The index was built on the adequacy model and consisted of the four dimensions of health care access or utilization, quality of care, linkages to care and social determinants of health. This conceptual grounding is essential for the robustness and validity of an index (Barclay et al., 2019; OECD, 2008), and its significance will be discussed further when findings are linked to theory in sub-section 8.7 of this Chapter 8. The C₃MH index fills a gap in literature of a comprehensive and multidimensional measure of the CoC, and one particularly targeted at the subnational context of a country (Chapter 7). This is particularly important because the district level bears the mandate for health reform in the country (Department of Health, 2017b). Thus, the use of the index can support evidence-based decision making at that level. It can also be adapted to other LMICs through the transparent methodological approach presented in Chapter 6.

8.5 Performance of the index and indicators in North West Province

The proposed indicators and index were tested with data from the North West province and its four districts in the period 2013-2017. Only data for 25/39 indicators from the proposed indicator set for South Africa were found in the North West province. This was indicative of

the data quality and availability issues persistent in South Africa (Bradshaw et al., 2008; Department of Health, 2012a; Garrib et al., 2008; Mphatswe et al., 2012). Similar data issues are expected to be prevalent in other LMICs (Mbondji et al., 2014; Mutale et al., 2013; Sheikh, 2014), and this study discussed the importance of assessing measurement gaps and their implications when reporting on CoC performance (Chapter 7). Current studies just report on data for available indicators, without discussing implications of the undermeasured aspects of the CoC (Chapter 3). The comprehensive approach proposed in this study argues for the assessment of both available and unavailable indicators, guided by a coherent theoretical approach (sub-section 8.7).

The lack of data at subnational levels impedes informed decision making on service provision and health outcome improvement. It creates a disconnect between the ideal set of indicators proposed for the country and the data available to measure them across different regions. It also impedes index measurement, and particularly its comparability across geographical areas within a country. Thus, as recommended best practice disaggregated analysis of indicators was conducted alongside the index in order to enable transparency and valid comparisons of districts (Chapter 6). Disaggregated analysis uncovers the types of indicators that contributed to the index within a given area. It also allows for recommendations to improve service provision across specific interventions.

The C₃MH index showed gradual improvements in CoC performance in the North West province and its districts during the period of 2013-2017 (Chapter 6). The index was significantly associated with other indices of development (Human Development Index (Klasen, 2018)) and the institutional maternal mortality ratio (iMMR) at the provincial level. The former reveals the validity of the index to health and development measurement; the latter was expected due to the known relationship of CoC interventions with maternal health

outcomes (Girum & Wasie, 2017; WHO, 2009). Even so, the correlation between the index and iMMR was not significant at the district level. Besides theoretical explanations related to complexity (sub-section 8.7), the result may also be linked to data quality issues at that level, the variation in data sources at district and provincial levels, and data reliability issues related to MMR estimates in South Africa (Department of Health et al., 2017). Thus, for future research and application to other LMICs, it is important to consider the harmonization of indicators and data sources between levels of care, as well as the implications for interpretation of the index where this is lacking.

8.6 Integrated analytical framework of the CoC

To integrate findings and discuss their potential application to research and practice in South Africa and other LMICs, an analytical framework was proposed in Chapter 7. This analytical framework has the potential to contribute to existing monitoring and evaluation frameworks for health and development in South Africa and other LMICs. An example is the multisectoral Medium Term Expenditure Frameworks (MTEF) that support action on social determinants of health and monitoring of health related indicators in LMIC governments (CSDH, 2008).

In South Africa, the MTEF is embedded in the Medium Term Strategic Framework (MTSF), which coordinates the work of multiple sectors towards national development goals (Department of Planning Monitoring and Evaluation, 2019). Maternal health, as one of the priority health goals in South Africa is monitored at a high level through the MTSF. Through the analytical approach proposed in this thesis, tools such as the C₃MH index can be included in the MTSF and used to enhance monitoring of performance on maternal health. In particular, this approach complements the pervasive use of the MMR as an outcome indicator: while the MMR is a complex outcome that is not determined by one particular intervention (Girum &

Wasie, 2017; Rogo et al., 2006; Say et al., 2014), the C₃MH index is a comprehensive proxy of performance by multiple sectors and can be disaggregated to make specific policy and action recommendations.

The analytical framework of CoC can also complement outcome indicator monitoring at national level by bringing more attention to inputs, processes and outputs. Currently, these indicators are largely missing for the maternal health programme in the annual plan for 2018/19- 2020/21 in South Africa, unlike other programmes for HIV, TB and child health (Department of Health, 2018a). There are also limited programme indicators for maternal health at the provincial level in South Africa (North West Department of Health, 2017, 2019). Like the proposal for the MTSF, decision makers within the health system can use the framework to understand and improve the monitoring of strategic programmatic indicators across the continuum. Adoption of the analytical framework, particularly the measurement and monitoring of the C₃MH index, will necessitate a collaborative process for setting indicator targets (Maternal Health Task Force, 2020; Moller et al., 2019; WHO, 2014, Smith et al., 2008). This process can be laden with political and hierarchical dynamics (Gunning-Schepers & Herten, 2000; Nuti et al., 2017), and should be supported by best available scientific evidence and other methodological proposals as detailed in Chapters 6 and 7.

8.7 Theoretical/methodological reflections for CoC measurement and monitoring

In this research, the health system was viewed as a complex adaptive system with emergent properties such as an effective CoC. As an emergent property the CoC was studied as a whole beyond its individual parts (Carmichael & Hadžikadić, 2019; Holden, 2005), or the interventions outlined in the service organization frameworks for LMICs (Kerber et al., 2007) and South Africa (Bradshaw et al., 2008). There is no consensus in current literature about the

definition of an effective continuum of care. However, there is the hypothesis that an effective CoC would be associated with positive maternal health outcomes and research has been recommended in that regard (Kerber et al., 2007). In this research, a metric for the CoC called the C₃MH index was developed, measured and assessed for its relationship with maternal health outcomes (Chapter 6). There was an indication that there may be a positive relationship between the index and MMR in facilities (Chapter 6). That finding may support the view in this thesis about the measurable nature of the CoC and its potential role as a performance metric for the health system.

To understand the underlying structure of the CoC, a critical realist perspective that embraces complexity thinking was adopted (Zachariadis, Scott, & Barrett, 2013a). In critical realism, the available evidence about the CoC was used to hypothesize about its underlying structure in a process called *retroduction* (Zachariadis, Scott, & Barrett, 2013a). Retroduction was demonstrated in this research through the development of the adequacy model and the C₃MH index based on systematic review of literature, review of indicators and interviews with experts (Chapters 3-6). This multifaceted evidence represented the evidence in the *empirical domain* of the CoC according to critical realist theory, which describes what is known about in South Africa (and to some extent, other LMICs). In retroduction, we use what we are able to observe as a starting point to make hypothesis about underlying structures and unobserved components.

Indicators in the empirical domain are expected to differ between countries, regions and even facilities depending on service availability and capacity, data collection and reporting, and public health priorities among other factors. This study indeed found different indicators for CoC across LMICs (Chapter 3), and a disparity between the proposed set of indicators for South Africa and what was monitored in the North West province and its districts (Chapter 6). The existence of different indicators does not preclude the determination of an underlying

structure for the CoC that is generalizable across contexts (Carmichael & Hadžikadić, 2019; Zachariadis, Scott, & Barrett, 2013a). They merely represent the manifestation of the CoC influenced by contextual factors, an important consideration in critical realist and complexity theory.

The adequacy model and subsequently the four-dimensional C₃MH index emerged from evidence through a critical interpretive synthesis and provided insights about the potential underlying structure of the CoC (Chapter 3). The model and index highlighted essential dimensions that transcend the specific indicators used to track interventions: It is expected that in any given context, the presence of good quality of care, well performing social indicators, high coverage across health service indicators, and effective linkages of care will lead to stronger CoC and better maternal health outcomes. The proposed dimensionality underpins any kind of indicators found in different contexts and thus provides a uniform conceptual and analytical approach for measurement and monitoring of the CoC.

The emergence of the adequacy model and the index contributed to knowledge of the *real domain* of the CoC, which had been identified as a gap in current literature. Using the adequacy model and C₃MH index, hypothesis can then be made about CoC performance and associated outcomes in different contexts. This is an area of additional future research: to test the proposed underlying structure of the CoC with *actual* events/outcomes in different contexts within and across countries. If valid, the proposed index and adequacy model should explain performance of the CoC and associated outcomes and enable recommendations for service improvements for maternal health. In this study, the adequacy model and index were valid for use to track and compare performance over time and analyse monitoring and evaluation and service improvements that were needed within districts and the province. The C₃MH index is not expected to be useful for cross-country comparisons however, even though the analytical

approach can be adapted to different contexts. Instead, it captures the inherent nature of the CoC and its' monitoring within a defined context to improve service provision.

This study has also contributed to literature on the use of mixed methods research to understand programming and improvement of care practices in maternal health in LMICs (Dougherty et al., 2018; Gupta et al., 2017; Lawry et al., 2017; Mourtada et al., 2019). The study demonstrated how both qualitative and quantitative data contributed to holistic understanding on the phenomenon of CoC. Further, triangulation of the evidence enabled articulation of a common analytical framework that can guide future research and practice. Using the analytical framework, health system performance in maternal health can be measured, recommendations for monitoring and evaluation as well as service provision made, and the CoC as a determinant of maternal health outcomes understood better.

There are many factors responsible for maternal health outcomes within any given context (Russ et al., 2013), the CoC being one of them. This was outlined in the life course health development (LCHD) framework adopted to understand health determinants in this study (Chapter 1). Experts in this study also reflected on factors relevant to the macro-context of maternal health outcome development (Chapter 5). In addition, the LCHD also informed the framing of the importance timing of care and the relevance of other sectors to CoC performance: In the LCHD framework, the relevant non-health sectors and factors fall within the same macro-context as the health system (Halfon & Hochstein, 2002). To that end, in Chapter 5 experts discussed the multisectoral nature of proposed indicators and the framework in general. And the analytical framework in Chapter 7 supported recommendations regarding relevance of the CoC to multisectoral collaboration.

8.8 Limitations

The analytical framework proposed in this study is applicable to the South African context, but its elements need to be studied further for suitability in other LMICs. The use of a systematic review and evidence synthesis across LMICs means that the adequacy model and C₃MH index can be explanatory regardless of country context. Expert consultation and evidence-based approaches will be necessary for selection of country-specific indicators in other LMICs. While this may lead to differences in findings for the assessment of validity, feasibility and relevance of indicators, it is to be expected, as the goal is to ensure an approach that best fits a country context instead of cross-national comparisons. In addition, the research did not test the index and indicators in other contexts within South Africa besides the North West province and its districts. However, since the proposed indicators are nationally representative, the methods proposed in this thesis are transferable to other provinces and districts in the country. The evaluation of the analytical framework as a whole, not just its individual components, was not explored in the study. For instance, implementation research was not carried out to test the application of the analytical framework within a health system context, which may lead to modification of its elements. This exercise was beyond the time and resource constraints of this research.

The researcher influenced the critical interpretive synthesis, selection of indicators, the choice of study setting, the interpretation of expert inputs, and the formulation and calculation of the C₃MH index. Each phase of the study was reported through a transparent process and peer reviewed publication in order to improve rigour and minimize researcher bias. In addition, each phase has the inherent biases and limitations discussed in the respective chapters. As a sequential study, the biases and limitations inherent in one phase may carry over to the next.

The transparency regarding limitations at each phase will thus make other researchers aware before they reproduce the study or apply its components.

The lingering data quality issues observed in the North West Province and its districts are expected to have impacted the reliable estimation of the index performance. In addition, the social determinants of health indicator data for the provincial and district level were obtained from different sources. The more frequent source of data, the General Household Survey (GHS), did not have data for the district level. The less frequent Community Survey and Census had a more limited set of indicator data available at the district level. Although some indicators were the same across surveys, the lingering discrepancies affected the comparability of provincial and district level estimates and recommendations were made regarding interpretation of the data. In other LMIC contexts, it is thus recommended that comparable sources be used to gather sub-national data.

8.9 Future research and recommendations

This study laid the groundwork for a measurement and monitoring approach for the CoC for maternal health in South Africa and other LMIC contexts. Future implementation research can explore the integration of the findings in policy and practice for public health and health systems (Bhattacharyya et al., 2009). By so doing, the research will enhance the utility and interpretation of the CoC framework for maternal health programs in the future. In this study, recommendations were made regarding improved measurement and monitoring of interventions in the future. One of the recommendations related to integrated analysis of health and non-health sector data, in a way that promotes co-accountability between the sectors responsible for maternal health determinants and outcomes. Future research was recommended to develop suitable indicators for monitoring multisectoral collaboration on the CoC for

maternal health. The development of new indicators will have implications for the health information system, in terms of integration and monitoring of data from other sectors that influence health.

The main challenges to the comprehensive monitoring of the CoC are data quality and availability issues common in South Africa and other LMICs. The analysis of indicator and C₃MH index data in the North West led to recommendations on health information system strengthening to improve data reporting and quality. This will make future estimates of the C₃MH index and its indicators more reliable, thus enhancing the utility of the metrics for policy and planning. It is anticipated that computation of the index and validation of indicators within the health system will require considerable capacity by health information personnel and managers. In the future, the authors aim to develop standard tools for use in easily accessible software (such as MS Excel) to facilitate the operationalization of the index computation. Participatory action research could also be used to build capacity and assess the operationalization of the analytical tools. This participatory action research may be based at lower levels of the system (district and provincial), as this has been shown to improve utilization of health information and support decision making (Dagneu et al., 2018; Otieno et al., 2020; Wude et al., 2020).

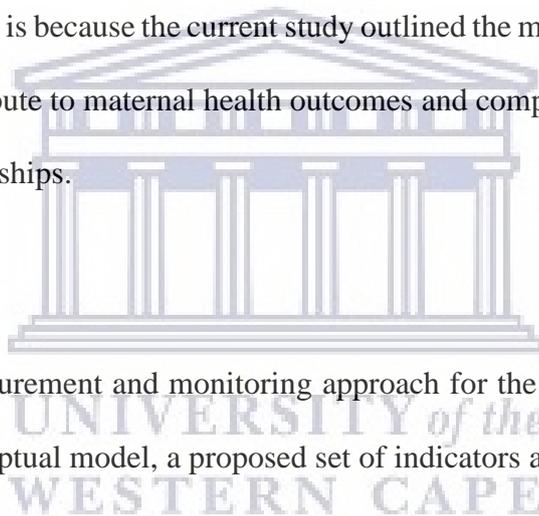
Various improvements need to be made in the measurement of indicators for interventions along the CoC. To illustrate, this research integrated the use of a facility readiness assessment, the Ideal Clinic Realization and Maintenance Program, to incorporate quality of care into the C₃MH index (Department of Health, 2018b; Hunter et al., 2017). The limitation of facility assessment used in LMIC settings is that they are largely input based (Brizuela et al., 2019); inadequately capturing observational data for content of care (Chapter 4). Where feasible, observational data should be used to measure content of care, as this is the gold standard for

assessing quality of care and complements structural or input indicators (de Graft-Johnson et al., 2017; Rosen et al., 2015). Future research could explore how observational data of quality of care can be used to enhance measurement of this dimension of the CoC.

Lastly, future research is recommended to investigate the complex relationship between the CoC and maternal health and other outcomes. This includes further exploration and validation of the relationship between CoC performance and maternal health outcomes in other districts in South Africa. In addition, the complex interrelationships between elements of the CoC can be explored. Although mapping of the complex mechanisms at play in CoC service provision and outcomes was beyond the scope of this study, current findings provide a useful starting point for that analysis. This is because the current study outlined the multidimensional elements of the CoC that can contribute to maternal health outcomes and complexity analysis can begin to assess their interrelationships.

8.10 Conclusion

This study defined a measurement and monitoring approach for the CoC for maternal health that entailed a novel conceptual model, a proposed set of indicators and a composite index for tracking performance. The study fills a current gap in public health research and practice in South Africa and other LMICs, characterized by fragmented and limited monitoring and evaluation of the CoC for maternal health. The proposed adequacy conceptual model described the CoC in a multidimensional manner, highlighting the importance of not just access and utilization of health services, but quality of care, linkages of care, and social determinants of health as well. The adequacy model also guided the assessment of a broad set of indicators and development of the C₃MH index for monitoring performance over time and place. The C₃MH index was used to monitor performance in the North West province and its four districts over



the period 2013-2017. The index value increased gradually over that period, as a result of various service improvements across dimensions of the CoC. Data quality and availability issues still pose a challenge to analysis of the proposed indicators and index: recommendations for health information system improvements and data harmonization across household surveys were made.

The proposed approach for CoC measurement and monitoring holds both the health system and other relevant sectors accountable for maternal health outcomes. In order to strengthen the implementation of the approach in policy and practice, this study highlighted the importance of stakeholder consultations. Stakeholders possessed contextual knowledge of public health challenges and monitoring and evaluation across the CoC in South Africa. Thus, they were a key resource in the interpretation of the validity, feasibility and relevance of the proposed indicators in South Africa. A similar approach will be necessary in future research in other LMIC contexts, in order to capture the unique factors relevant to the suitability of the proposed approach in each country. To that end, the proposed C₃MH index is not designed for comparisons across countries with inherent differences in public health interventions and their monitoring and evaluation. The index instead plays a complementary role to existing indices for cross-country comparisons; it offers an approach for subnational level analysis to supports localized decision making and encompasses a broad set of indicators.

The analytical framework proposed through this research offers a uniform approach for assessment of the CoC across LMIC contexts. It focuses on how the insights from mixed methods research can be integrated and interpreted as a standard methodology for CoC measurement and monitoring, regardless of context. The analytical framework demonstrated the relationship between the adequacy model, the proposed indicator set for South Africa and the composite C₃MH index. It described the main steps for a holistic assessment of the CoC,

as well as some of the considerations for the validity of the approach in its totality. The analytical framework used critical realist theory to demonstrate the distinctions between the theoretical and empirical elements of the proposed measurement and monitoring approach. Further research is needed to explore how the analytical framework and its individual components can be implemented in other LMICs and South Africa. That research will have implications for future refinement of the analytical framework and support service improvements and decision-making in maternal health.



References

- Abegunde, D., Orobato, N., Sadauki, H., & Bassi, A. (2015). Countdown to 2015 : Tracking Maternal and Child Health Intervention Targets Using Lot Quality Assurance Sampling in Bauchi State. *PLoS ONE*, *10*(6), 1–14. <https://doi.org/10.1371/journal.pone.0129129>
- Abegunde, D., Orobato, N., Shoretire, K., Ibrahim, M., Mohammed, Z., Abdulazeez, J., Gwamzhi, R., & Ganiyu, A. (2015). Monitoring maternal, newborn, and child health interventions using lot quality assurance sampling in Sokoto State of northern Nigeria. *Global Health Action*, *8*(1), 27526. <https://doi.org/10.3402/gha.v8.27526>
- Agyepong, I. A., Sewankambo, N., Binagwaho, A., Coll-Seck, A. M., Corrah, T., Ezeh, A., Fekadu, A., Kilonzo, N., Lamptey, P., Masiye, F., Mayosi, B., Mboup, S., Muyembe, J. J., Pate, M., Sidibe, M., Simons, B., Tlou, S., Gheorghe, A., Legido-Quigley, H., ... Piot, P. (2017). The path to longer and healthier lives for all Africans by 2030: the Lancet Commission on the future of health in sub-Saharan Africa. *The Lancet*, *390*(10114), 2803–2859. [https://doi.org/10.1016/S0140-6736\(17\)31509-X](https://doi.org/10.1016/S0140-6736(17)31509-X)
- Akhlaq, A., McKinstry, B., Muhammad, K. Bin, & Sheikh, A. (2016). Barriers and facilitators to health information exchange in low- and middle-income country settings: A systematic review. *Health Policy and Planning*, *31*(9), 1310–1325. <https://doi.org/10.1093/heapol/czw056>
- Akinyemi, J. O., Afolabi, R. F., & Awolude, O. A. (2016). Patterns and determinants of dropout from maternity care continuum in Nigeria. *BMC Pregnancy and Childbirth*, *16*(1), 282. <https://doi.org/10.1186/s12884-016-1083-9>
- Alvesson, M., & Skoldberg, K. (2009). Post-positivism, social constructionism, critical realism: three reference points in the philosophy of science. In M. Alvesson & K. Skoldberg (Eds.), *Reflexive Methodology: New Vistas for Qualitative Research* (Second Edn, pp. 15–52). Sage Publications Inc.
- Anto-Ocrah, M., Cushman, J., Sanders, M., & De Ver Dye, T. (2020). A woman's worth: An access framework for integrating emergency medicine with maternal health to reduce the burden of maternal mortality in sub-Saharan Africa. *BMC Emergency Medicine*, *20*(1), 1–8. <https://doi.org/10.1186/s12873-020-0300-z>
- Arsenault, C., Jordan, K., Lee, D., Dinsa, G., Manzi, F., Marchant, T., & Kruk, M. E. (2018). Equity in antenatal care quality: an analysis of 91 national household surveys. *The Lancet Global Health*, *6*(11), e1186–e1195. [https://doi.org/10.1016/S2214-109X\(18\)30389-9](https://doi.org/10.1016/S2214-109X(18)30389-9)
- Ashish, K., Bhandari, A., Pradhan, Y., KC, N., Upreti, S., Thapa, K., Sharma, G., Upreti, S., Aryal, D., Dhakwa, J., & Pun, A. (2011). State of maternal , newborn and child health programmes in Nepal : what may a continuum of care model mean for more effective and efficient service delivery? *Journal of the Nepal Health Research Council*, *9*(19), 92–100.
- Ataguba, J. E., Day, C., & McIntyre, D. (2014). Monitoring and Evaluating Progress towards Universal Health Coverage in South Africa. *PLoS Medicine*, *11*(9), 9–11.

<https://doi.org/10.1371/journal.pmed.1001686>

- ATLAS.ti Scientific Software Development GmbH. (2016). *ATLAS.ti 8 Windows* (8.0.43.0). ATLAS.ti Scientific Software Development GmbH. <http://atlasti.com/product/v8-windows/?q=v8-product-page/>
- Atun, R. (2012). Health systems, systems thinking and innovation. *Health Policy and Planning*, 27(suppl 4), iv4–iv8. <https://doi.org/10.1093/heapol/czs088>
- Bam, N., Marcus, T., Hugo, J., & Kinkel, H. F. (2013). Conceptualizing community oriented primary care (COPC) - The Tshwane, South Africa, health post model. *African Journal of Primary Health Care and Family Medicine*, 5(1), 54–56.
- Bamford, L. (2012). Maternal, Newborn and Child Health. In A. Padarath & R. English (Eds.), *South African Health Review 2012/2013* (2012/2013, pp. 49–66). Health Systems Trust.
- Barasa, E., Nguhiu, P., & McIntyre, D. (2018). Measuring progress towards Sustainable Development Goal 3.8 on universal health coverage in Kenya. *BMJ Global Health*, 3(3), 1–13. <https://doi.org/10.1136/bmjgh-2018-000904>
- Barclay, M., Dixon-woods, M., & Lyratzopoulos, G. (2019). The problem with composite indicators. *BMJ Quality and Safety*, 28, 338–344. <https://doi.org/10.1136/bmjqs-2018-007798>
- Barnett-Page, E., & Thomas, J. (2009). Methods for the synthesis of qualitative research: a critical review. In *NCRM Working Paper Series* (01/09). <https://doi.org/10.1186/1471-2288-9-59>
- Baron, E. C., Hanlon, C., Mall, S., Honikman, S., Breuer, E., Kathree, T., Luitel, N. P., Nakku, J., Lund, C., Medhin, G., Patel, V., & Petersen, I. (2016). Maternal mental health in primary care in five low- and middle-income countries : a situational analysis. *BMC Health Services Research*, 16(53). <https://doi.org/10.1186/s12913-016-1291-z>
- Barros, A. J. D., & Victora, C. G. (2013). Measuring Coverage in MNCH: Determining and Interpreting Inequalities in Coverage of Maternal, Newborn, and Child Health Interventions. *PLoS Medicine*, 10(5), e1001390. <https://doi.org/10.1371/journal.pmed.1001390>
- Bates, I., Chapotera, G. K., McKew, S., & van den Broek, N. (2008). Maternal mortality in sub-Saharan Africa: the contribution of ineffective blood transfusion services. *BJOG : An International Journal of Obstetrics and Gynaecology*, 115(11), 1331–1339. <https://doi.org/10.1111/j.1471-0528.2008.01866.x>
- Bautista-Arredondo, S., Gadsden, P., Harris, J. E., & Bertozzi, S. M. (2008). Optimizing resource allocation for HIV/AIDS prevention programmes: an analytical framework. *AIDS (London, England)*, 22(Suppl 1), 67–74. <https://doi.org/10.1097/01.aids.0000327625.69974.08>
- Begg, K., Mamdoo, P., Dudley, L., Andrews, G., Engelbrecht, J., & Lebeso, L. (2018). Development of a national strategic framework for a high-quality health system in South Africa. In L. C. Rispel & A. Padarath (Eds.), *South African Health Review 2018* (2018th

ed., pp. 77–86). Health Systems Trust.

- Begun, J. W., Zimmerman, B., & Dooley, K. (2003). Health Care Organizations as Complex Adaptive Systems. *Advances in Health Care Organization Theory*, 33(3), 253–288. <https://doi.org/10.1177/009430610403300325>
- Benova, L., Moller, A. B., & Moran, A. C. (2019). “What gets measured better gets done better”: The landscape of validation of global maternal and newborn health indicators through key informant interviews. *PLoS ONE*, 14(11), e0224746. <https://doi.org/https://doi.org/10.1371/journal.pone.0224746>
- Bhardwaj, S., Pattinson, R., Sa, F., Kauchali, S., Sa, F., Dlamini, N., Marshall, C., Sa, F., Merwe, M. Van Der, Sa, R. D., Barron, P., & Sa, F. (2018). Implementation of strategies to improve programme effectiveness lead to an improvement in maternal and child health outcomes in South Africa. *South Africa Medical Journal*, 108(March), 44–52. <https://doi.org/10.7196/SAMJ.2018.v108i3.12812>
- Bhattacharyya, O., Reeves, S., & Zwarenstein, M. (2009). What Is Implementation Research? *Research on Social Work Practice*, 19(5), 491–502. <https://doi.org/10.1177/1049731509335528>
- Bhattacharjee, A. (2012). Social Science Research: Principles, Methods and Practices. In *Scholar Commons Textbooks Collection* (2nd ed., Vol. 3). USF Tampa Library Open Access Collections at Scholar Commons.
- Birch, S., Kephart, G., Tomblin-Murphy, G., O’Brien-Pallas, L., Alder, R., & MacKenzie, A. (2007). Human resources planning and the production of health: A needs-based analytical framework. *Canadian Public Policy*, 33(Suppl.). <https://doi.org/10.3138/9R62-Q0V1-L188-1406>
- Black, R. E., Levin, C., Walker, N., Chou, D., Liu, L., & Temmerman, M. (2016). Reproductive, maternal, newborn, and child health: Key messages from Disease Control Priorities 3rd Edition. *The Lancet*, 388(10061), 2811–2824. [https://doi.org/10.1016/S0140-6736\(16\)00738-8](https://doi.org/10.1016/S0140-6736(16)00738-8)
- Blas, E., Ataguba, J. E., Huda, T. M., Bao, G. K., Rasella, D., & Gerecke, M. R. (2016). The feasibility of measuring and monitoring social determinants of health and the relevance for policy and programme - a qualitative assessment of four countries. *Global Health Action*, 9(1). <https://doi.org/10.3402/gha.v9.29002>
- Blas, E., Kurup, A. S., & World Health Organization. (2010). *Equity, Social Determinants and Public Health Programmes* (E. Blas & A. S. Kurup (eds.)). World Health Organization. <https://doi.org/10.2323/jgam.51.385>
- Blas, E., Roebbel, N., Rajan, D., & Valentine, N. (2016). Intersectoral planning for health and health equity. In G. Schemts, D. Rajan, & S. Kadandale (Eds.), *Strategizing national health in the 21st century: A Handbook*. World Health Organization.
- Boerma, T., Bryce, J., Kinfu, Y., Axelson, H., Victora, C. G., Bernstein, S., Kirkwood, B., & Hosseinpoor, A. (2008). Mind the gap: equity and trends in coverage of maternal, newborn, and child health services in 54 countdown countries. *The Lancet*, 371(9620),

1259–1267. [https://doi.org/10.1016/S0140-6736\(08\)60560-7](https://doi.org/10.1016/S0140-6736(08)60560-7)

- Boerma, T., Requejo, J., Victora, C. G., Amouzou, A., George, A., Agyepong, I., Barroso, C., Barros, A. J. D., Bhutta, Z. A., Black, R. E., Borghi, J., Buse, K., Aguirre, L. C., Chopra, M., Chou, D., Chu, Y., Claeson, M., Daelmans, B., Davis, A., ... Zaidi, S. (2018). Countdown to 2030: tracking progress towards universal coverage for reproductive, maternal, newborn, and child health. *The Lancet*, *391*(10129), 1538–1548. [https://doi.org/10.1016/S0140-6736\(18\)30104-1](https://doi.org/10.1016/S0140-6736(18)30104-1)
- Bolarinwa, O. (2015). Principles and methods of validity and reliability testing of questionnaires used in social and health science researches. *Nigerian Postgraduate Medical Journal*, *22*(4), 195. <https://doi.org/10.4103/1117-1936.173959>
- Bomela, N. J. (2020). Maternal mortality by socio-demographic characteristics and cause of death in South Africa: 2007-2015. *BMC Public Health*, *20*(1), 1–20. <https://doi.org/10.1186/s12889-020-8179-x>
- Bonde, M., Bossen, C., & Danholt, P. (2019). Data-work and friction: Investigating the practices of repurposing healthcare data. *Health Informatics Journal*, *25*(3), 558–566. <https://doi.org/10.1177/1460458219856462>
- Booyesen, F. (2002). An overview and evaluation of composite indices of development. *Social Indicators Research*, *59*(2), 115–151. <https://doi.org/10.1023/A:1016275505152>
- Bradshaw, D., Chopra, M., Kerber, K., Lawn, J. E., Bamford, L., Moodley, J., Patrick, M., Stephen, C., & Velaphi, S. (2008). Every death counts: use of mortality audit data for decision making to save the lives of mothers, babies, and children in South Africa. *Lancet*, *371*(9620), 1294–1304. [https://doi.org/10.1016/S0140-6736\(08\)60564-4](https://doi.org/10.1016/S0140-6736(08)60564-4)
- Bradshaw, D., Chopra, M., Kerber, K., Lawn, J., Moodley, J., Pattinson, R., Patrick, M., Stephen, C., & Velaphi, S. (2008). *Every Death Counts: Saving the Lives of Mothers, Babies and Children in South Africa*. <http://www.mrc.ac.za/sites/default/files/attachments/2016-06-30/edcrptfinal.pdf>
- Brizuela, V., Leslie, H. H., Sharma, J., Langer, A., & Tuncalp, O. (2019). Measuring quality of care for all women and newborns : how do we know if we are doing it right ? A review of facility assessment tools. *The Lancet Global Health*, *7*(5), 624–632. [https://doi.org/10.1016/S2214-109X\(19\)30033-6](https://doi.org/10.1016/S2214-109X(19)30033-6)
- Bryce, J., Arnold, F., Blanc, A., Hancioglu, A., Newby, H., & Requejo, J. (2013). Measuring Coverage in MNCH : New Findings , New Strategies , and Recommendations for Action. *PLoS Medicine*, *10*(5), e1001423. <https://doi.org/10.1371/journal.pmed.1001423>
- Burchett, H. E., & Mayhew, S. H. (2009). Maternal mortality in low-income countries: what interventions have been evaluated and how should the evidence base be developed further? *International Journal of Gynaecology and Obstetrics*, *105*(1), 78–81. <https://doi.org/10.1016/j.ijgo.2008.12.022>
- Burger, R., Ranchod, S., Rossouw, L., & Smith, A. (2016). Strengthening the measurement of quality of care. In A. Paradath, J. King, E. Mackie, & J. Casciola (Eds.), *South African Health Review 2016* (p. 191). Health Systems Trust.

- Calciolari, S., & Ilinca, S. (2011). Comparing (and learning from) integrated care initiatives: an analytical framework. *Journal of Integrated Care*, 19(6), 4–13. <https://doi.org/https://doi.org/10.1108/14769011111191412>
- Calvello, E. J., Skog, A. P., Tenner, A. G., & Wallis, L. A. (2015). Applying the lessons of maternal mortality reduction to global emergency health. *Bulletin of the World Health Organization*, 93(6), 417–423. <https://doi.org/10.2471/BLT.14.146571>
- Cameron, J. I., Naglie, G., Silver, F. L., & Gignac, M. A. . (2013). Stroke family caregivers' support needs change across the care continuum: a qualitative study using the timing it right framework. *Disability and Rehabilitation*, 35(4), 315–324. <https://doi.org/https://doi.org/10.3109/09638288.2012.691937>
- Carmichael, T., & Hadžikadić, M. (2019). The fundamentals of complex adaptive systems. In T. Carmichael, A. Collins, & M. Hadžikadić (Eds.), *Complex Adaptive Systems: Understanding Complex Systems* (Issue July, pp. 1–16). Springer, Cham. https://doi.org/http://doi-org-443.webvpn.fjmu.edu.cn/10.1007/978-3-030-20309-2_1
- Chersich, M. F., Luchters, S., Blaauw, D., Scorgie, F., Kern, E., Van Den Heever, A., Rees, H., Peach, E., Kharadi, S., & Fonn, S. (2016). Safeguarding maternal and child health in South Africa by starting the child support grant before birth: Design lessons from pregnancy support programmes in 27 countries. *South African Medical Journal*, 106(12), 1192–1210. <https://doi.org/10.7196/SAMJ.2016.v106i12.12011>
- Chola, L., Pillay, Y., Barron, P., Tugendhaft, A., Kerber, K., & Hofman, K. (2015). Cost and impact of scaling up interventions to save lives of mothers and children: taking South Africa closer to MDGs 4 and 5. *Global Health Action*, 8, 27265. <https://doi.org/10.3402/gha.v8.27265>
- Chopra, M., Daviaud, E., Pattinson, R., Fonn, S., & Lawn, J. E. (2009). Saving the lives of South Africa's mothers, babies, and children: can the health system deliver? *The Lancet*, 374(9692), 835–846. [https://doi.org/10.1016/S0140-6736\(09\)61123-5](https://doi.org/10.1016/S0140-6736(09)61123-5)
- Chopra, M., Lawn, J. E., Sanders, D., Barron, P., Karim, S. S. A., Bradshaw, D., Jewkes, R., Karim, Q. A., Flisher, A. J., Mayosi, B. M., Tollman, S. M., Churchyard, G. J., & Coovadia, H. (2009). Achieving the health Millennium Development Goals for South Africa: challenges and priorities. *The Lancet*, 374(9694), 1023–1031. [https://doi.org/10.1016/S0140-6736\(09\)61122-3](https://doi.org/10.1016/S0140-6736(09)61122-3)
- Chweneyagae, D., Delis-Jarrosay, N., Farina, Z., Fawcus, S., Godi, N. P., Khaole, N., Kunene, B., Mhlanga, R. E., Mbambisa, G. Z., Mbombo, N., Molefe, N. E., Moodley, J., Moran, N. F., Pattinson, R. C., Rout, C., Schoon, M., & Seabe, S. J. (2012). The impact of HIV infection on maternal deaths in South Africa. *South African Journal of Obstetrics and Gynaecology*, 18(3), 70–76. <https://doi.org/10.7196/SAJOG.581>
- Cooper, D., Morroni, C., Orner, P., Moodley, J., Harries, J., Cullingworth, L., & Hoffman, M. (2004). Ten years of democracy in South Africa: Documenting transformation in reproductive health policy and status. *Reproductive Health Matters*, 12(24), 70–85. [https://doi.org/10.1016/S0968-8080\(04\)24143-X](https://doi.org/10.1016/S0968-8080(04)24143-X)
- Coovadia, H., Jewkes, R., Barron, P., Sanders, D., & McIntyre, D. (2009). The health and

- health system of South Africa: historical roots of current public health challenges. *The Lancet*, 374(9692), 817–834. [https://doi.org/10.1016/S0140-6736\(09\)60951-X](https://doi.org/10.1016/S0140-6736(09)60951-X)
- Coxon, K. (2005). Common Experiences of Staff Working in Integrated Health and Social Care Organisations : A European Perspective. *Journal of Integrated Care*, 13(2), 13–21. <https://doi.org/https://doi.org/10.1108/14769018200500012>
- Creswell, J. (2003). *Research Design: Qualitative, Quantitative and Mixed Methods Approaches* (2nd ed.). SAGE Publications, Inc. <https://doi.org/10.1017/CBO9781107415324.004>
- Commission on Social Determinants of Health (CSDH). (2008). *Closing the gap in a generation: health equity through action on the social determinants of health*. <https://doi.org/10.1080/17441692.2010.514617>
- Dagneu, E., Woreta, S. A., & Shiferaw, A. M. (2018). Routine health information utilization and associated factors among health care professionals working at public health institution in North Gondar, Northwest Ethiopia. *BMC Health Services Research*, 18(1), 1–8. <https://doi.org/10.1186/s12913-018-3498-7>
- Damian, D. J., Njau, B., Lisasi, E., Msuya, S. E., & Boulle, A. (2019). Trends in maternal and neonatal mortality in South Africa: A systematic review. *Systematic Reviews*, 8(1), 1–13. <https://doi.org/10.1186/s13643-019-0991-y>
- Day, C., & Gray, A. (2017). Health and Related Indicators. In A. Paradath & P. Baron (Eds.), *South African Health Review* (pp. 217–328). Health Systems Trust. <http://www.hst.org.za/publications/south-african-health-review-2017>
- Day, C., Gray, A., & Ndlovu, N. (2018). Health and related indicators. In L. C. Rispel & A. Paradath (Eds.), *South African Health Review* (pp. 139–250). Health Systems Trust. <https://doi.org/10.1007/s13398-014-0173-7.2>
- De Andrade, L. O. M., Filho, A. P., Solar, O., Rígoli, F., De Salazar, L. M., Serrate, P. C. F., Ribeiro, K. G., Koller, T. S., Cruz, F. N. B., & Atun, R. (2015). Social determinants of health, universal health coverage, and sustainable development: Case studies from Latin American countries. *The Lancet*, 385(9975), 1343–1351. [https://doi.org/10.1016/S0140-6736\(14\)61494-X](https://doi.org/10.1016/S0140-6736(14)61494-X)
- de Graft-Johnson, J., Kerber, K., Tinker, A., Otchere, S., Narayanan, I., Shoo, R., Oluwole, D., & Lawn, J. (2006). The maternal, newborn, and child health continuum of care. In J. Lawn & K. Kerber (Eds.), *Opportunities for Africa's Newborns* (pp. 24–36). World Health Organization. <https://doi.org/10.3402/gha.v1i0.1828>
- de Graft-Johnson, J., Vesel, L., Rosen, H. E., Rawlins, B., Abwao, S., Mazia, G., Bozsa, R., Mwebesa, W., Khadka, N., Kamunya, R., Getachew, A., Tibaijuka, G., Rakotovao, J. P., & Tekleberhan, A. (2017). Cross-sectional observational assessment of quality of newborn care immediately after birth in health facilities across six sub-Saharan African countries. *BMJ Open*, 7(3), e014680. <https://doi.org/10.1136/bmjopen-2016-014680>
- Dean, S. V., Lassi, Z. S., Imam, A. M., & Bhutta, Z. A. (2014). Preconception care : closing the gap in the continuum of care to accelerate improvements in maternal , newborn and

child health. *Reproductive Health*, 11(Suppl 3), 1–8. <https://doi.org/10.1186/1742-4755-11-S3-S1>

Department of Health. (2011a). *District Health Management Information System (DHMIS) Policy*. https://www.idealhealthfacility.org.za/docs/policies/District Health Management Information System Policy_2011.pdf

Department of Health. (2011b). *National core standards for Health Establishments in South Africa: Abridged Version*. <http://www.rhap.org.za/wp-content/uploads/2014/05/National-Core-Standards-2011-1.pdf>

Department of Health. (2011c). “Towards *Quality Care for Patients*” *National Core Standards for Health Establishments in South Africa*. <http://www.rhap.org.za/wp-content/uploads/2014/05/National-Core-Standards-2011-1.pdf>

Department of Health. (2012a). *Health Data Advisory and Co-Ordination Committee (HDACC) Report*. <http://www.health.gov.za/index.php/2014-08-15-12-55-04/category/100-2012rp?download=187:health-data-advisory-and-co-ordination-committee-hdacc-report>

Department of Health. (2012b). *National Contraception and Fertility Planning Policy and Service Delivery Guidelines*. <https://health-e.org.za/wp-content/uploads/2014/05/ContraceptionPolicyServiceDelGuidelines2013.pdf>

Department of Health. (2012c). *Quality Improvement Guide – the key to providing improved quality of care*. <https://www.idealhealthfacility.org.za/docs/guidelines/Quality Improvement Guide 2012.pdf>

Department of Health. (2012d). *South Africa’s National Strategic Plan for a Campaign on Accelerated Reduction of Maternal and Child Mortality in Africa (CARMMA)*. https://health-e.org.za/wp-content/uploads/2015/09/Strategic_Plan_Campaign_on_Accelerated_Reduction_of_Maternal_and_Child_Mortality_in_Africa.pdf

Department of Health. (2012e). *Strategic Plan for Maternal, Newborn, Child and Women’s Health (MNCWH) and Nutrition in South Africa: 2012-2016*. <http://www.health.gov.za/index.php/2014-08-15-12-54-26/category/95-2012s#>

Department of Health. (2014). *Strategic Plan 2014/15 - 2018/19*. <http://www.health.gov.za/docs/strategic/2013/strategicplan.pdf>

Department of Health. (2015). *Integrated Clinical Services Management*. <https://www.idealhealthfacility.org.za/docs/Integrated Clinical Services Management Manual 5th June FINAL.pdf>

Department of Health. (2016). *NIDS Data Element: National Indicator Data Set Data Element Definitions April 2017 to March 2019*. <https://dd.dhmis.org/>

Department of Health. (2017a). *Annual Performance Plan 2017/18*. <http://health.nwpg.gov.za/index.php/latest-developments/all-documents/nwhealth-documents/annual-peformance-plans.html>

- Department of Health. (2017b). *District Health Planning and Monitoring Framework*.
http://www.health.gov.za/DHP/docs/DHP_and_M_Framework_and_Guidelines_25Aug_DG.pdf
- Department of Health. (2017c). “*How the Ideal Clinic came about.*”
<https://www.idealclinic.org.za/>
- Department of Health. (2017d). *Ideal Clinic Definitions, Components and Checklists* (Issue April). [https://www.idealhealthfacility.org.za/docs/v17/Final Ideal Clinic Framework - version 17 on 3 Aug 2017.pdf](https://www.idealhealthfacility.org.za/docs/v17/Final%20Ideal%20Clinic%20Framework%20-%20version%2017%20on%203%20Aug%202017.pdf)
- Department of Health. (2018a). *Annual Performance Plan 2018/19 - 2020/21*.
<http://www.health.gov.za/index.php/2014-03-17-09-09-38/annual-performance-plans?download=4491:ndoh-annual-performance-plan-parliament>
- Department of Health. (2018b). *Ideal Clinic Definitions, Components and Checklists* (Issue July). [https://www.idealhealthfacility.org.za/docs/v18/Final Ideal Clinic Framework - version 18 \(26 July 2018\).pdf](https://www.idealhealthfacility.org.za/docs/v18/Final%20Ideal%20Clinic%20Framework%20-%20version%2018%20(26%20July%202018).pdf)
- Department of Health. (2018c). *National Department of Health Annual Report 2018/19*.
<http://www.health.gov.za/index.php/2014-08-15-12-56-31?download=3688:annual-report-2018-2019>
- Department of Health. (2019). *Data File: NIDS Integrated*. The NDOH Data Dictionary.
[https://dd.dhmis.org/orgunits.html?file=NIDS Integrated&source=nids&ver=22b8](https://dd.dhmis.org/orgunits.html?file=NIDS%20Integrated&source=nids&ver=22b8)
- Department of Health, Statistics South Africa, South African Medical Research Council, & ICF. (2017). *South Africa Demographic and Health Survey 2016: Key Indicator Report*.
<https://doi.org/10.1017/CBO9781107415324.004>
- Department of Health, Statistics South Africa, South African Medical Research Council, & ICF. (2019). *South Africa Demographic and Health Survey 2016*.
<https://dhsprogram.com/pubs/pdf/FR337/FR337.pdf>
- Department of Planning Monitoring and Evaluation. (2011). *Development Indicators 2011*.
[https://www.dpme.gov.za/keyfocusareas/outcomesSite/Development Indicators/Development Indicators 2011.pdf](https://www.dpme.gov.za/keyfocusareas/outcomesSite/Development%20Indicators/Development%20Indicators%202011.pdf)
- Department of Planning Monitoring and Evaluation. (2019). *Medium-Term Strategic Framework MTSF 2014-2019*.
https://www.gov.za/sites/default/files/gcis_document/201409/mtsf2014-2019.pdf
- Deribew, A., Ojal, J., Karia, B., Bauni, E., & Oteinde, M. (2016). Under-five mortality rate variation between the Health and Demographic Surveillance System (HDSS) and Demographic and Health Survey (DHS) approaches. *BMC Public Health*, *16*(1), 1–7.
<https://doi.org/10.1186/s12889-016-3786-2>
- Dettrick, Z., Gouda, H. N., Hodge, A., & Jimenez-Soto, E. (2016). Measuring quality of maternal and newborn care in developing countries using demographic and health surveys. *PLoS ONE*, *11*(6), 1–21. <https://doi.org/10.1371/journal.pone.0157110>
- Dixon-Woods, M., Cavers, D., Agarwal, S., Annandale, E., Arthur, A., Harvey, J., Hsu, R.,

- Katbamna, S., Olsen, R., Smith, L., Riley, R., & Sutton, A. J. (2006). Conducting a critical interpretive synthesis of the literature on access to healthcare by vulnerable groups. *BMC Medical Research Methodology*, 6(35). <https://doi.org/10.1186/1471-2288-6-35>
- Dougherty, L., Stammer, E., Derbile, E., Dery, M., Yahaya, W., Gle, D. B., Otieno, J., & Fotso, J. C. (2018). A Mixed-Methods Evaluation of a Community-Based Behavior Change Program to Improve Maternal Health Outcomes in the Upper West Region of Ghana. *Journal of Health Communication*, 23(1), 80–90. <https://doi.org/10.1080/10810730.2017.1414901>
- Draper, C. E., Micklesfield, L. K., Kahn, K., Tollman, S. M., Pettifor, J. M., Dunger, D. B., Norris, S. A., & Ntshembo Consortium. (2014). Application of Intervention Mapping to develop a community-based health promotion pre-pregnancy intervention for adolescent girls in rural South Africa : Project Ntshembo (Hope). *BMC Public Health*, 14 (Suppl(S5)). <https://doi.org/10.1186/1471-2458-14-S2-S5>
- English, R., Masilela, T., Barron, P., & Schonfeldt, A. (2011). Health Information Systems in South Africa. In A. Paradath & R. English (Eds.), *South African Health Review* (pp. 81–89). Health Systems Trust. https://www.hst.org.za/publications/South African Health Reviews/sahr_2011.pdf
- Eoyang, G., Dynamics, H. S., & Berkas, T. (1998). Evaluation in a Complex Adaptive System. In M. Lissack & H. Gunz (Eds.), *Managing Complexity in Organizations*. Quorum Books.
- Farmer, T., Robinson, K., Elliott, S. J., & Eyles, J. (2006). Developing and implementing a triangulation protocol for qualitative health research. *Qualitative Health Research*, 16(3), 377–394. <https://doi.org/10.1177/1049732305285708>
- Fereday, J., & Muir-Cochrane, E. (2006). Demonstrating Rigor Using Thematic Analysis: A Hybrid Approach of Inductive and Deductive Coding and Theme Development Jennifer. *International Journal of Qualitative Methods*, 5(1). http://www.ualberta.ca/~iiqm/backissues/5_1/pdf/fereday.pdf
- Firoz, T., McCaw-Binns, A., Filippi, V., Magee, L. A., Costa, M. L., Cecatti, J. G., Barreix, M., Adanu, R., Chou, D., Say, L., Barbour, K., Cottler, S., Fawole, O., Gadama, L., Ghérissi, A., Gyte, G., Hindin, M., Jayathilaka, A., Kalamar, A., ... von Dadelszen, P. (2018). A framework for healthcare interventions to address maternal morbidity. *International Journal of Gynecology and Obstetrics*, 141(Suppl 1), 61–68. <https://doi.org/10.1002/ijgo.12469>
- Flemming, K. (2010). Synthesis of quantitative and qualitative research: An example using Critical Interpretive Synthesis. *Journal of Advanced Nursing*, 66(1), 201–217. <https://doi.org/10.1111/j.1365-2648.2009.05173.x>
- Flenady, V., Wojcieszek, A. M., Fjeldheim, I., Friberg, I. K., Nankabirwa, V., Jani, J. V., Myhre, S., Middleton, P., Crowther, C., Ellwood, D., Tudehope, D., Pattinson, R., Ho, J., Matthews, J., Ortega, A. B., & Venkateswaran, M. (2016). eRegistries : indicators for the WHO Essential Interventions for reproductive , maternal , newborn and child health. *BMC Pregnancy & Childbirth*, 16(293), 1–15. <https://doi.org/10.1186/s12884-016->

- Footman, K., Benova, L., Goodman, C., Macleod, D., Lynch, C. A., Penn-Kekana, L., & Campbell, O. M. R. (2015). Using multi-country household surveys to understand who provides reproductive and maternal health services in low- and middle-income countries: A critical appraisal of the Demographic and Health Surveys. *Tropical Medicine and International Health*, 20(5), 589–606. <https://doi.org/10.1111/tmi.12471>
- Fried, J., Sunderji, A., Birch, S., & Eyles, J. (2013). The reason that I did not go – determinants of the use of antenatal care services in South Africa , two decades after the end of apartheid. *Canadian Journal of African Studies*, 47(1), 27–50. <https://doi.org/10.1080/00083968.2013.770340>
- Fujita, M., Poudel, K. C., Do Thi, N., Bui Duc, D., Nguyen Van, K., Green, K., Nguyen Thi Minh, T., Kato, M., Jacka, D., Cao Thi Thanh, T., Nguyen Thanh, L., & Jimba, M. (2012). A new analytical framework of “continuum of prevention and care” to maximize HIV case detection and retention in care in Vietnam. *BMC Health Services Research*, 12(1), 1–12. <https://doi.org/10.1186/1472-6963-12-483>
- Garenne, M., Kahn, K., Collinson, M. A., & Gómez-olivé, F. X. (2013). Maternal mortality in rural South Africa : the impact of case definition on levels and trends. *International Journal of Women’s Health*, 5, 457–463. <https://doi.org/10.2147/IJWH.S45983>
- Garenne, M., McCaa, R., & Nacro, K. (2011). Maternal mortality in South Africa: an update from the 2007 Community Survey. *Journal of Population Research*, 28(1), 89–101. <https://doi.org/10.1007/s12546-010-9037-y>
- Garrib, A., Stoops, N., Mckenzie, A., Dlamini, L., Govender, T., Rohde, J., & Herbst, K. (2008). An evaluation of the District Health Information System in rural South Africa. *South African Medical Journal*, 98(7), 549–552. <http://www.samj.org.za/index.php/samj/article/view/426>
- Ghandi, M., Welz, T., & Ronsmans, C. (2004). Severe acute maternal morbidity in rural South Africa. *International Journal of Gynecology and Obstetrics*, 87(2), 180–187. <https://doi.org/https://doi.org/10.1016/j.ijgo.2004.07.012>
- Gillespie, S. (2018). Measurement of nutrition interventions along the RMNCAH continuum of care : lessons and challenges. *International Food Policy Research Institute, Stellenbosch, 31 January 2018*. <https://www.ifpri.org/profile/stuart-gillespie>
- Girum, T., & Wasie, A. (2017). Correlates of maternal mortality in developing countries: an ecological study in 82 countries. *Maternal Health, Neonatology and Perinatology*, 3(19), 1–6. <https://doi.org/10.1186/s40748-017-0059-8>
- Gough, D., Thomas, J., & Oliver, S. (2012). Clarifying differences between review designs and methods. *Systematic Reviews*, 1(1), 28. <https://doi.org/10.1186/2046-4053-1-28>
- Graham, W. J., & Varghese, B. (2012). Quality, quality, quality: Gaps in the continuum of care. *The Lancet*, 379(9811), e5–e6. [https://doi.org/10.1016/S0140-6736\(10\)62267-2](https://doi.org/10.1016/S0140-6736(10)62267-2)
- Gupta, M., Bosma, H., Angeli, F., Kaur, M., Chakrapani, V., Rana, M., & Van Schayck, O. C. P. (2017). A mixed methods study on evaluating the performance of a multi-strategy

- national health program to reduce maternal and child health disparities in Haryana, India. *BMC Public Health*, 17(1), 1–13. <https://doi.org/10.1186/s12889-017-4706-9>
- Habicht, J. P., Victora, C. G., & Vaughan, J. P. (1999). Evaluation designs for adequacy, plausibility and probability of public health programme performance and impact. *International Journal of Epidemiology*, 28(1), 10–18. <https://doi.org/10.1093/ije/28.1.10>
- Halfon, N., & Hochstein, M. (2002). Life Course Health Development: An Integrated Framework for Developing Health, Policy, and Research. *The Milbank Quarterly*, 80(3), 433–479. <https://doi.org/https://dx.doi.org/10.1111%2F1468-0009.00019>
- Halfon, N., Larson, K., Lu, M., Tullis, E., & Russ, S. (2014). Lifecourse health development: Past, present and future. *Maternal and Child Health Journal*, 18(2), 344–365. <https://doi.org/10.1007/s10995-013-1346-2>
- Herbst, K., Burn, A., & Nzimande, N. (2002). Public Health Data Sources. In P. Ijumba, A. Ntuli, & P. Barron (Eds.), *South African Health Review* (pp. 373–388). Health Systems Trust. <https://www.hst.org.za/publications/South African Health Reviews/SAHR2002.pdf>
- Heredia-pi, I., Servan-mori, E., Darney, B. G., Reyes-morales, H., & Lozano, R. (2016). Measuring the adequacy of antenatal health care : a national cross-sectional study in Mexico. *Bulletin of the World Health Organization*, 94, 452–461. <https://doi.org/http://dx.doi.org/10.2471/BLT.15.168302>
- Hind, D. (2017). Using a logic model and a triangulation protocol: integrative quantitative and qualitative data. *The 4th International Clinical Trials Methodology Conference (ICTMC) and the 38th Annual Meeting of the Society for Clinical Trials, 07–10 May 2017*. <https://doi.org/DOI 10.1186/s13063-017-1902-y>
- Hipgrave, D. B., Bolsewicz, K., & Anderson, I. (2014). Social Science & Medicine Health sector priority setting at meso-level in lower and middle income countries : Lessons learned , available options and suggested steps. *Social Science & Medicine*, 102, 190–200. <https://doi.org/10.1016/j.socscimed.2013.11.056>
- Hodgins, S., & D'Agostino, A. (2014). The quality–coverage gap in antenatal care: toward better measurement of effective coverage. *Global Health, Science and Practice*, 2(2), 173–181. <https://doi.org/10.9745/GHSP-D-13-00176>
- Hogan, D. R., Stevens, G. A., Hosseinpoor, A. R., & Boerma, T. (2018). Monitoring universal health coverage within the Sustainable Development Goals : development and baseline data for an index of essential health services. *The Lancet Global Health*, 6(2), e152–e168. [https://doi.org/10.1016/S2214-109X\(17\)30472-2](https://doi.org/10.1016/S2214-109X(17)30472-2)
- Holden, L. M. (2005). Complex adaptive systems: Concept analysis. *Journal of Advanced Nursing*, 52(6), 651–657. <https://doi.org/10.1111/j.1365-2648.2005.03638.x>
- Honikman, S., van Heyningen, T., Field, S., Baron, E., & Tomlinson, M. (2012). Stepped care for maternal mental health: A case study of the perinatal mental health project in South Africa. *PLoS Medicine*, 9(5). <https://doi.org/10.1371/journal.pmed.1001222>
- Horwood, C., Haskins, L., Vermaak, K., Phakathi, S., Subbaye, R., & Doherty, T. (2010).

Prevention of mother to child transmission of HIV (PMTCT) programme in KwaZulu-Natal , South Africa : an evaluation of PMTCT implementation and integration into routine maternal , child and women ' s health services. *Tropical Medicine and International Health*, 15(9), 992–999. <https://doi.org/10.1111/j.1365-3156.2010.02576.x>

Hulton, L., Matthews, Z., Martin-Hilber, A., Adanu, R., Ferla, C., Getachew, A., Makwenda, C., Segun, B., & Yilla, M. (2014). Using evidence to drive action: A “revolution in accountability” to implement quality care for better maternal and newborn health in Africa. *International Journal of Gynecology and Obstetrics*, 127(1), 96–101. <https://doi.org/10.1016/j.ijgo.2014.07.002>

Hunter, J., Asmall, S., Ravhengani, N. M., Chandran, T. M., Tucker, J.-M., & Mokgalagadi, Y. (2017). The Ideal Clinic in South Africa: progress and challenges in implementation. In A. Padarath & P. Barron (Eds.), *South African Health Review* (pp. 111–124). Health Systems Trust.

Jacobs, B., Ir, P., Bigdeli, M., Annear, P. L., & Van Damme, W. (2012). Addressing access barriers to health services: An analytical framework for selecting appropriate interventions in low-income Asian countries. *Health Policy and Planning*, 27(4), 288–300. <https://doi.org/10.1093/heapol/czr038>

Jonas, K., Crutzen, R., Van Den Borne, B., Sewpaul, R., & Reddy, P. (2016). Teenage pregnancy rates and associations with other health risk behaviours: A three-wave cross-sectional study among South African school-going adolescents. *Reproductive Health*, 13(1), 50. <https://doi.org/10.1186/s12978-016-0170-8>

Kabeer, N. (2009). Social Exclusion, Poverty and Discrimination Towards an Analytical Framework. *IDS Bulletin*, 31(4), 83–97. <https://doi.org/https://doi.org/10.1111/j.1759-5436.2000.mp31004009.x>

Kahn, K., Collinson, M. A., Xavier Gomez-olivier, F., Mokoena, O., Twine, R., Mee, P., Afolabi, S. A., Clark, B. D., Kabudula, C. W., Khosa, A., Khoza, S., Shabangu, M. G., Silaule, B., Tibane, J. B., Wagner, R. G., Garenne, M. L., Clark, S. J., & Tollman, S. M. (2012). Profile: Agincourt Health and Socio-demographic Surveillance System. *International Journal of Epidemiology*, 41(4), 988–1001. <https://doi.org/10.1093/ije/dys115>

Kautzky, K., & Tollman, S. M. (2008). A Perspective on Primary Health Care in South Africa. In P. Barron & J. Roma-Reardon (Eds.), *South African Health Review* (pp. 17–30). Health Systems Trust. <https://www.hst.org.za/publications/South African Health Reviews/sahr2008.pdf>

Kendall, T., Danel, I., Cooper, D., Dilmitis, S., Kaida, A., Kourtis, A. P., Langer, A., Lapidus-Salaiz, I., Lathrop, E., Moran, A. C., Sebitloane, H., Turan, J. M., Watts, D. H., & Wegner, M. N. (2014). Eliminating Preventable HIV-Related Maternal Mortality in Sub-Saharan Africa: What Do We Need to Know? *Journal of Acquired Immune Deficiency Syndromes (1999)*, 67 Suppl 4, S250-8. <https://doi.org/10.1097/QAI.0000000000000377>

Kerber, K. J., de Graft-Johnson, J. E., Bhutta, Z. A., Okong, P., Starrs, A., & Lawn, J. E. (2007). Continuum of care for maternal, newborn, and child health: from slogan to

service delivery. *Lancet*, 370(9595), 1358–1369. [https://doi.org/10.1016/S0140-6736\(07\)61578-5](https://doi.org/10.1016/S0140-6736(07)61578-5)

Khanna, R., & Sri, B. S. (2020). *Social determinants approach to maternal deaths*. Maternal, Newborn, Child and Adolescent Health.

https://www.who.int/maternal_child_adolescent/epidemiology/maternal-death-surveillance/case-studies/india-social-determinants/en/

Khumalo, F. (2006). Health Management Information Systems. In A. Paradath & P. Ijumba (Eds.), *South African Health Review 2006* (pp. 65–76). Health Systems Trust.

<https://www.hst.org.za/publications/South African Health Reviews/sahr2006.pdf>

Kikuchi, K., Ansah, E. K., Okawa, S., Enuameh, Y., Yasuoka, J., Nanishi, K., Shibanuma, A., Gyapong, M., Owusu-Agyei, S., Oduro, A. R., Asare, G. Q., Hodgson, A., Jimba, M., Yoneyama, Y., Appiah-Denkyira, E., Addei, S., Kukula, V., Sarpong, D., Narh, C., ... Kamiya, Y. (2015). Effective linkages of continuum of care for improving neonatal, perinatal, and maternal mortality: A systematic review and meta-analysis. *PLoS ONE*, 10(9). <https://doi.org/10.1371/journal.pone.0139288>

Kikuchi, K., Ansah, E., Okawa, S., Shibanuma, A., Gyapong, M., Owusu-Agyei, S., Oduro, A., Quansah-Asare, G., Hodgson, A., & Jimba, M. (2015). Ghana's Ensure Mothers and Babies Regular Access to Care (EMBRACE) program: study protocol for a cluster randomized controlled trial. *Trials*, 16(1), 22. <https://doi.org/10.1186/s13063-014-0539-3>

Kinney, M. V., Kerber, K. J., Black, R. E., Cohen, B., Nkrumah, F., Coovadia, H., Nampala, P. M., Lawn, J. E., Axelson, H., Bergh, A.-M., Chopra, M., Diab, R., Friberg, I., Odubanjo, O., Walker, N., & Weissman, E. (2010). Sub-Saharan Africa's mothers, newborns, and children: where and why do they die? *PLoS Medicine*, 7(6), e1000294. <https://doi.org/10.1371/journal.pmed.1000294>

Klasen, S. (2018). Human Development Indices and Indicators: A Critical Evaluation. 2018 *UNDP Human Development Report Office Background Paper*, 123. http://www.hdr.undp.org/sites/default/files/2018_human_development_statistical_update.pdf%0Ahdr.undp.org/en/statistics/hdi

Klazinga, N., Stronks, K., Delnoij, D., & Verhoeff, A. (2001). Indicators without a cause. Reflections on the development and use of indicators in health care from a public health perspective. *International Journal for Quality in Health Care*, 13(6), 433–438. <https://doi.org/10.1093/intqhc/13.6.433>

Kollen, B. J., Groenier, K. H., & Berendsen, A. J. (2011). Patients' experiences with continuum of care across hospitals. A multilevel analysis of Consumer Quality Index Continuum of Care. *Patient Education and Counseling*, 83(2), 269–272. <https://doi.org/10.1016/j.pec.2010.04.035>

Kotelchuck, M. (1994). An evaluation of the Kessner Adequacy of Prenatal Care Index and a proposed Adequacy of Prenatal Care Utilization Index. *American Journal of Public Health*, 84(9), 1414–1420. <https://doi.org/10.2105/AJPH.84.9.1414>

Kruk, M. E., Gage, A. D., Arsenault, C., Jordan, K., Leslie, H. H., Roder-dewan, S., Adeyi,

- O., Barker, P., Twum-danso, N. A. Y., & Pate, M. (2018). High-quality health systems in the Sustainable Development Goals era : time for a revolution. *The Lancet Global Health*, 6, E1196-252. [https://doi.org/10.1016/S2214-109X\(18\)30386-3](https://doi.org/10.1016/S2214-109X(18)30386-3)
- Kumar, C., Singh, P. K., & Rai, R. K. (2013). Coverage gap in maternal and child health services in India: Assessing trends and regional deprivation during 1992-2006. *Journal of Public Health*, 35(4), 598–606. <https://doi.org/10.1093/pubmed/fds108>
- Kuruvilla, S., Schweitzer, J., Bishai, D., Chowdhury, S., Caramani, D., Frost, L., Cortez, R., Daelmans, B., de Francisco, A., Adam, T., Cohen, R., Alfonso, Y. N., Franz-Vasdeki, J., Saadat, S., Pratt, B. A., Eugster, B., Bandali, S., Venkatachalam, P., Hinton, R., ... Bustreo, F. (2014). Success factors for reducing maternal and child mortality. *Bulletin of the World Health Organization*, 92(7), 533–544. <https://doi.org/10.2471/BLT.14.138131>
- Lavender, D. T. (2016). Improving quality of care during labour and childbirth and in the immediate postnatal period. *Best Practice and Research: Clinical Obstetrics and Gynaecology*, 36, 57–67. <https://doi.org/10.1016/j.bpobgyn.2016.05.011>
- Lawry, L., Canteli, C., Rabenzanahary, T., & Pramana, W. (2017). A mixed methods assessment of barriers to maternal, newborn and child health in gogrial west, south Sudan. *Reproductive Health*, 14(1), 1–13. <https://doi.org/10.1186/s12978-016-0269-y>
- Layer, E. H., Kennedy, C. E., Beckham, S. W., Mbwambo, J. K., Likindikoki, S., Davis, W. W., Kerrigan, D. L., & Brahmabhatt, H. (2014). Multi-Level Factors Affecting Entry into and Engagement in the HIV Continuum of Care in Iringa , Tanzania. *PLoS ONE*, 9(8), e104961. <https://doi.org/10.1371/journal.pone.0104961>
- Lewin, S., Glenton, C., Munthe-Kaas, H., Carlsen, B., Colvin, C. J., G??mezoglu, M., Noyes, J., Booth, A., Garside, R., & Rashidian, A. (2015). Using Qualitative Evidence in Decision Making for Health and Social Interventions: An Approach to Assess Confidence in Findings from Qualitative Evidence Syntheses (GRADE-CERQual). *PLoS Medicine*, 12(10), 1–19. <https://doi.org/10.1371/journal.pmed.1001895>
- Maina, I., Wanjala, P., Soti, D., Kipruto, H., Droti, B., & Boerma, T. (2017). Using health-facility data to assess subnational coverage of maternal and child health indicators, Kenya. *Bulletin of the World Health Organization*, 95(10), 683–694. <https://doi.org/10.2471/BLT.17.194399>
- Malakoane, B., Heunis, J. C., Chikobvu, P., Kigozi, N. G., & Kruger, W. H. (2020). Public health system challenges in the Free State , South Africa : a situation appraisal to inform health system strengthening. *BMC Health Services Research*, 20(58), 1–14. <https://doi.org/https://doi.org/10.1186/s12913-019-4862-y> (2020)
- Marchant, T., Tilley-Gyado, R. D., Tessema, T., Singh, K., Gautham, M., Umar, N., Berhanu, D., Cousens, S., & Armstrong Schellenberg, J. R. M. (2015). Adding content to contacts: Measurement of high quality contacts for maternal and newborn health in Ethiopia, North East Nigeria, and Uttar Pradesh, India. *PLoS ONE*, 10(5), 1–20. <https://doi.org/10.1371/journal.pone.0126840>
- Maternal Health Task Force. (2020). *Developing a Monitoring Framework for Ending Preventable Maternal Mortality (EPMM)*. Centre of Excellence in Maternal and Child

- Health. <https://www.mhtf.org/developing-a-monitoring-framework-for-ending-preventable-maternal-mortality/#Targets>
- Mayosi, B. M., Lawn, J. E., van Niekerk, A., Bradshaw, D., Abdool Karim, S. S., & Coovadia, H. M. (2012). Health in South Africa: changes and challenges since 2009. *Lancet*, *380*(9858), 2029–2043. [https://doi.org/10.1016/S0140-6736\(12\)61814-5](https://doi.org/10.1016/S0140-6736(12)61814-5)
- Mazor, K. M., Street, R. L., Sue, V. M., Williams, A. E., Rabin, B. A., & Arora, N. K. (2016). Patient Education and Counseling Assessing patients' experiences with communication across the cancer. *Patient Education and Counseling*, *99*(8), 1343–1348. <https://doi.org/10.1016/j.pec.2016.03.004>
- Mbondji, P. E., Kebede, D., Soumbey-Alley, E. W., Zielinski, C., Kouvidila, W., & Lusamba-Dikassa, P. S. (2014). Health information systems in Africa: Descriptive analysis of data sources, information products and health statistics. *Journal of the Royal Society of Medicine*, *107*, 34–45. <https://doi.org/10.1177/0141076814531750>
- Mcevoy, P., & Richards, D. (2006). A critical realist rationale for using a combination of quantitative and qualitative methods. *Journal of Research in Nursing*, *11*(1), 66–78. <https://doi.org/10.1177/1744987106060192>
- McNairy, M. L., & El-Sadr, W. M. (2012). The HIV care continuum: no partial credit given. *AIDS*, *26*(14), 1735–1738. <https://doi.org/10.1097/QAD.0b013e328355d67b>
- Meline, T. (2006). Selecting studies for systematic review: Inclusion and exclusion criteria. *Contemporary Issues in Communication Science and Disorders*, *33*, 21–27. <https://doi.org/10.1092-5171/06/3301-0021>
- Merali, H. S., Lipsitz, S., Hevelone, N., Gawande, A. A., Lashoher, A., Agrawal, P., & Spector, J. (2014). Audit-identified avoidable factors in maternal and perinatal deaths in low resource settings: A systematic review. *BMC Pregnancy and Childbirth*, *14*(280). <https://doi.org/10.1186/1471-2393-14-280>
- Meystre, S. M., Lovis, C., Bürkle, T., Tognola, G., Budrionis, A., & Lehmann, C. U. (2017). Clinical Data Reuse or Secondary Use: Current Status and Potential Future Progress. *Yearbook of Medical Informatics*, *26*(1), 38–52. <https://doi.org/10.15265/IY-2017-007>
- Mikkelsen, E. M., Cronin-fenton, D., Kristensen, N. R., & Pedersen, L. (2017). Missing data and multiple imputation in clinical epidemiological research. *Clinical Epidemiology*, *15*(9), 157–166. <https://doi.org/https://doi.org/10.2147/clep.s129785>
- Mnyani, C. N., Buchmann, E. J., Chersich, M. F., Frank, K. A., & McIntyre, J. A. (2017). Trends in maternal deaths in HIV-infected women, on a background of changing HIV management guidelines in South Africa: 1997 to 2015. *Journal of the International AIDS Society*, *20*(3), 1–11. <https://doi.org/10.1002/jia2.25022>
- Moller, A. B., Newby, H., Hanson, C., Morgan, A., El Arifeen, S., Chou, D., Diaz, T., Say, L., Askew, I., & Moran, A. C. (2018). Measures matter: A scoping review of maternal and newborn indicators. *PLoS ONE*, *13*(10), 1–19. <https://doi.org/10.1371/journal.pone.0204763>
- Moller, A. B., Patten, J. H., Hanson, C., Morgan, A., Say, L., Diaz, T., & Moran, A. C.

- (2019). Monitoring maternal and newborn health outcomes globally: a brief history of key events and initiatives. *Tropical Medicine and International Health*, 24(12), 1342–1368. <https://doi.org/10.1111/tmi.13313>
- Moodley, J., Fawcus, F., & Pattinson, R. (2018). Improvements in maternal mortality in South Africa. *South African Medical Journal*, 108(3a), s4–s8. <https://doi.org/10.7196/SAMJ.2018.v108i3.12770>
- Moodley, J., Pattinson, R. C., Fawcus, S., Schoon, M. G., Moran, N., & Shweni, P. M. (2014). The Confidential Enquiry into Maternal Deaths in South Africa: a case study. *BJOG : An International Journal of Obstetrics and Gynaecology*, 121(Suppl. 4), 53–60. <https://doi.org/10.1111/1471-0528.12869>
- Moran, A. C., Jolivet, R. R., Chou, D., Dalglish, S. L., Hill, K., Ramsey, K., Rawlins, B., & Say, L. (2016). A common monitoring framework for ending preventable maternal mortality, 2015-2030: Phase I of a multi-step process. *BMC Pregnancy and Childbirth*, 16(1), 1–13. <https://doi.org/10.1186/s12884-016-1035-4>
- Moran, N. F., & Moodley, J. (2012). The effect of HIV infection on maternal health and mortality. *International Journal of Gynecology and Obstetrics*, 119(Suppl 1), 26–29. <https://doi.org/10.1016/j.ijgo.2012.03.011>
- Mothupi, M. C., De Man, J., Tabana, H., & Knight, L. (2020). Development and testing of a composite index to monitor the continuum of maternal health service delivery at provincial and district level in South Africa. *Research Square, Preprint*. <https://doi.org/https://doi.org/10.21203/rs.3.rs-97082/v1>
- Mothupi, M. C., Knight, L., & Tabana, H. (2019). Development of indicators to measure and monitor the continuum of care for maternal health in South Africa. *Unpublished Manuscript*.
- Mothupi, M. C., Knight, L., & Tabana, H. (2020a). Review of health and non-health sector indicators for monitoring service provision along the continuum of care for maternal health. *BMC Research Notes*, 13(151). <https://doi.org/https://dx.doi.org/10.21203/rs.2.22005/v3>
- Mothupi, M. C., Knight, L., & Tabana, H. (2020b). Improving the validity, relevance and feasibility of the continuum of care framework for maternal health in South Africa: a thematic analysis of experts' perspectives. *Health Research Policy and Systems*, 18(1), 28. <https://doi.org/10.1186/s12961-020-0537-8>
- Mothupi, M., Knight, L., & Tabana, H. (2018). Measurement approaches in continuum of care for maternal health: a critical interpretive synthesis of evidence from LMICs and its implications for the South African context. *BMC Health Services Research*, 18(539), 1–9. <https://doi.org/https://doi.org/10.1186/s12913-018-3278-4>
- Mourtada, R., Bottomley, C., Houben, F., Bashour, H., & Campbell, O. M. R. (2019). A mixed methods analysis of factors affecting antenatal care content: A Syrian case study. *PLoS ONE*, 14(3), 1–24. <https://doi.org/10.1371/journal.pone.0214375>
- Mphatswe, W., Mate, K. S., Bennett, B., Ngidi, H., Reddy, J., Barker, P. M., & Rollins, N.

- (2012). Improving public health information: a data quality intervention in KwaZulu-Natal, South Africa. *Bulletin of the World Health Organization*, 90(3), 176–182. <https://doi.org/10.2471/BLT.11.092759>
- Mucunguzi, S., Wamani, H., Lochoro, P., & Tylleskar, T. (2014). Effects of improved access to transportation on emergency obstetric care outcomes in Uganda. *African Journal of Reproductive Health*, 18(3), 87–94. <http://www.jstor.org/stable/24362067>
- Munos, M., Stanton, C. K., Bryce, J., Amouzou, A., Arnold, F., Blanc, A., Campbell, H., Eisele, T., Hancioglu, A., Marchant, T., & Stanton, C. (2017). Improving coverage measurement for reproductive, maternal, neonatal and child health: Gaps and opportunities. *Journal of Global Health*, 7(1), 1–11. <https://doi.org/10.7189/jogh.07.010801>
- Munro, S. A., Lewin, S. A., Smith, H. J., Engel, M. E., Fretheim, A., & Volmink, J. (2007). Patient Adherence to Tuberculosis Treatment : A Systematic Review of Qualitative Research. *PLoS Medicine*, 4(7), e238. <https://doi.org/10.1371/journal.pmed.0040238>
- Murray, C. J. L., & Frenk, J. (2000). A framework for assessing the performance of health systems. *Bulletin of the World Health Organization*, 78(6), 717–731. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2560787/pdf/10916909.pdf>
- Musgrove, P., Creese, A., Preker, A., Baeza, C., Anell, A., & Prentice, T. (2000). *The World Health Report 2000: Health Systems Improving Performance*. <https://doi.org/10.1146/annurev.ecolsys.35.021103.105711>
- Mutale, W., Chintu, N., Amoroso, C., Awoonor-Williams, K., Phillips, J., Baynes, C., Michel, C., Taylor, A., & Sherr, K. (2013). Improving health information systems for decision making across five sub-Saharan African countries: Implementation strategies from the African Health Initiative. *BMC Health Services Research*, 13(Suppl.2), 1–12. <https://doi.org/10.1186/1472-6963-13-S2-S9>
- Mwaniki, M. K., Baya, E. J., Mwangi-powell, F., & Sidebotham, P. (2016). ‘ Tweaking ’ the model for understanding and preventing maternal and neonatal morbidity and mortality in Low Income Countries : “ inserting new ideas into a timeless wine skin .” *BMC Pregnancy and Childbirth*, 16(14). <https://doi.org/10.1186/s12884-016-0803-5>
- National Committee for Confidential Enquiry into Maternal Deaths (NCCEMD). (2014). *Saving Mothers 2011-2013: Sixth report on confidential enquiries into maternal deaths in South Africa*. <http://www.health.gov.za/index.php/shortcodes/2015-03-29-10-42-47/2015-04-30-08-18-10/2015-04-30-08-24-27/category/559-saving-mothers?download=884:saving-mothers-2011-2013-sixth-report-on-confidential-enquiries-into-maternal-deaths-in-south-africa-fact-sh>
- National Committee for Confidential Enquiry into Maternal Deaths (NCCEMD). (2016a). *Saving Mothers 2014-2016 : Seventh triennial report on confidential enquiries into maternal deaths in South Africa*. <http://www.health.gov.za/index.php/shortcodes/2015-03-29-10-42-47/2015-04-30-08-18-10/2015-04-30-08-24-27/category/559-saving-mothers?download=884:saving-mothers-2011-2013-sixth-report-on-confidential-enquiries-into-maternal-deaths-in-south-africa-fact-sh>

- National Committee for Confidential Enquiry into Maternal Deaths (NCCEMD). (2016b). *Saving Mothers 2014-2016 : Seventh triennial report on confidential enquiries into maternal deaths in South Africa*. <http://www.health.gov.za/index.php/shortcodes/2015-03-29-10-42-47/2015-04-30-08-18-10/2015-04-30-08-24-27/category/559-saving-mothers?download=884:saving-mothers-2011-2013-sixth-report-on-confidential-enquiries-into-maternal-deaths-in-south-africa-fact-sh>
- Nesbitt, R. C., Lohela, T. J., Manu, A., Vesel, L., Okyere, E., Edmond, K., Owusu-agyei, S., Kirkwood, B. R., & Gabrysch, S. (2013). Quality along the Continuum : A Health Facility Assessment of Intrapartum and Postnatal Care in Ghana. *PLoS ONE*, 8(11), 1–11. <https://doi.org/10.1371/journal.pone.0081089>
- Noble, M., Barnes, H., Wright, G., McLennan, D., Avenell, D., Whitworth, A., & Roberts, B. (2009). *The South African Index of Multiple Deprivation 2001 at the Datazone Level*. <http://hdl.handle.net/20.500.11910/3865>
- North West Department of Health. (2015). *Annual Performance Plan 2015/16*. <http://health.nwpg.gov.za/index.php/latest-developments/all-documents/nwhealth-documents/annual-peformance-plans.html?download=59:nwdoh-app-2014-15>
- North West Department of Health. (2017). *Annual report 2016/17*. <http://www.nwpg.gov.za/Public Works/Documents/PolicyDoc/Public Works Annual Report 2016-17-soft copy.pdf>
- North West Department of Health. (2019). *Annual Performance Plan 2018/19*. <http://health.nwpg.gov.za/index.php/latest-developments/all-documents/nwhealth-documents/annual-peformance-plans.html>
- November, L., & Sandall, J. (2018). “Just because she’s young, it doesn’t mean she has to die”: Exploring the contributing factors to high maternal mortality in adolescents in Eastern Freetown; A qualitative study. *Reproductive Health*, 15(1), 1–18. <https://doi.org/10.1186/s12978-018-0475-x>
- Noyes, J., & Lewin, S. (2010). Chapter 5: Extracting qualitative evidence. In J. Noyes, A. Booth, K. Hannes, A. Harden, J. Harris, S. Lewin, & C. Lockwood (Eds.), *Supplementary Guidance for Inclusion of Qualitative Research in Cochrane Systematic Reviews of Interventions*. (Version 1). Cochrane Collaboration Qualitative Methods Group,. <http://methods.cochrane.org/qi/supplemental-handbook-guidance>
- O’Cathain, A., Murphy, E., & Nicholl, J. (2010). Three techniques for integrating data in mixed methods studies. *BMJ (Online)*, 341(7783), 1147–1150. <https://doi.org/10.1136/bmj.c4587>
- Organization for Economic Cooperation and Development (OECD). (2008). *Handbook on Constructing Composite Indicators: Methodology and User Guide*. OECD Publications. <https://doi.org/10.1111/jgs.13392>
- Oelke, N. D., Stiphout, M. L., Suter, E., Hepp, S., Rostami, M., Birney, A., Janke, R., & Van Vliet-Brown, C. (2016). Measuring intersectoral collaboration in a health care setting: A knowledge synthesis. *International Journal of Integrated Care*, 16(6), 11. <https://doi.org/10.5334/ijic.2954>

- Oguntunde, O., Yusuf, F. M., Nyenwa, J., Dauda, D. S., Salihu, A., & Sinai, I. (2018). Emergency transport for obstetric emergencies: Integrating community-level demand creation activities for improved access to maternal, newborn, and child health services in northern Nigeria. *International Journal of Women's Health, 10*, 773–782. <https://doi.org/10.2147/IJWH.S180415>
- Okawa, S., Gyapong, M., Leslie, H., Shibanuma, A., Kikuchi, K., Yeji, F., Tawiah, C., Addei, S., Nanishi, K., Oduro, A. R., Owusu-agyeyi, S., & Ansah, E. (2019). Effect of continuum-of-care intervention package on improving contacts and quality of maternal and newborn healthcare in Ghana: a cluster randomised controlled trial. *BMJ Open, 9*(e025347), 1–12. <https://doi.org/10.1136/bmjopen-2018-025347>
- Onono, M. A., Wahome, S., Wekesa, P., Adhu, C. K., Waguma, L. W., Serem, T., Owenga, M. A., & Ong'wen, P. (2019). Effects of an expanded Uber-like transport system on access to and use of maternal and newborn health services: Findings of a prospective cohort study in Homa Bay, Kenya. *BMJ Global Health, 4*(3), 1–8. <https://doi.org/10.1136/bmjgh-2018-001254>
- Otieno, M. O., Muiruri, M. L., & Kawila, C. (2020). Organizational Determinants Of Health Information Utilization In Making Decision Among Healthcare Managers In Mombasa County , Kenya. *Journal of Health Medicine and Nursing, 5*(2), 1–17. <https://www.iprjb.org/journals/index.php/JHMN/article/view/1075/1189>
- Owili, P. O., Adoyo Muga, M., Chou, Y.-J., Elsa Hsu, Y.-H., Huang, N., & Chien, L.-Y. (2016). Associations in the continuum of care for maternal, newborn and child health: a population-based study of 12 sub-Saharan Africa countries. *BMC Public Health, 16*(414), 1–15. <https://doi.org/10.1186/s12889-016-3075-0>
- Pacagnella, R. C., Cecatti, J. G., Osis, M. J., & Souza, J. P. (2012). The role of delays in severe maternal morbidity and mortality: Expanding the conceptual framework. *Reproductive Health Matters, 20*(39), 155–163. [https://doi.org/10.1016/S0968-8080\(12\)39601-8](https://doi.org/10.1016/S0968-8080(12)39601-8)
- Paina, L., & Peters, D. H. (2012). Understanding pathways for scaling up health services through the lens of complex adaptive systems. *Health Policy and Planning, 27*(5), 365–373. <https://doi.org/10.1093/heapol/czr054>
- Pattinson, R. C., Buchmann, E., Mantel, G., Schoon, M., & Rees, H. (2003). Can enquiries into severe acute maternal morbidity act as a surrogate for maternal death enquiries? *BJOG: An International Journal of Obstetrics and Gynaecology, 110*, 889–893. <https://obgyn.onlinelibrary.wiley.com/doi/epdf/10.1111/j.1471-0528.2003.03044.x>
- Pega, F., Valentine, N. B., Rasanathan, K., Hosseinpoor, R., Torgersen, T. P., Ramanathan, V., Posayanonda, T., Röbbel, N., Kalboussi, Y., & Rehkopf, D. H. (2017). The need to monitor actions on the social determinants of health. *Bulletin of the World Health Organization, 95*, 784–787. <https://doi.org/10.2471/BLT.16.184622>
- Petersen, I., & Lund, C. (2011). Mental health service delivery in South Africa from 2000 to 2010: One step forward, one step back. *South African Medical Journal, 101*(10), 751–757. <http://www.samj.org.za/index.php/samj/article/view/4841/3442%5Cnhttp://ovidsp.ovid>

com/ovidweb.cgi?T=JS&PAGE=reference&D=emed10&NEWS=N&AN=2011542801

- Pillay, Y., & Barron, P. (2018). On the path to reach the SDG targets: Decreasing maternal and child mortality in South Africa. *South Africa Medical Journal*, 3(Suppl 1), S2–S3. <https://doi.org/10.2471/blt.12.106807>
- Pillay, Y., & Barron, P. (2011). The implementation of PHC re-engineering in South Africa. *Public Health Association of South Africa*, 1–6. <https://www.phasa.org.za/wp-content/uploads/2011/11/Pillay-The-implementation-of-PHC.pdf>
- Plsek, P. E., & Greenhalgh, T. (2001). Complexity science The challenge of complexity in health care. *BMJ*, 323, 625–628. <https://doi.org/https://doi.org/10.1136/bmj.323.7313.625>
- PMNCH The Partnership For Maternal Newborn & Child Health. (2010). *Opportunities for Africa 's Newborns: Practical data, policy and programmatic support for newborn care in Africa*. [https://doi.org/10.1016/S0140-6736\(86\)91254-7](https://doi.org/10.1016/S0140-6736(86)91254-7)
- PMNCH The Partnership For Maternal Newborn & Child Health. (2011). *A Global Review of Key Interventions Related to Reproductive, Maternal, Newborn and Child Health*. https://www.who.int/pmnch/knowledge/publications/201112_essential_interventions/en/
- Profit, J., Typpo, K. V., Hysong, S. J., Woodard, L. D., Kallen, M. A., & Petersen, L. A. (2010). Improving benchmarking by using an explicit framework for the development of composite indicators : an example using pediatric quality of care. *Implementation Science*, 5, 1–10. <https://doi.org/https://doi.org/10.1186/1748-5908-5-13>
- Rai, R. K. (2014). Tracking women and children in a Continuum of Reproductive, Maternal, Newborn, and Child Healthcare (RMNCH) in India. *Journal of Epidemiology and Global Health*, 4(3), 239–243. <https://doi.org/10.1016/j.jegh.2013.12.006>
- Rai, R. K., Kumar, C., & Singh, P. K. (2012). District level coverage gap in Maternal, Newborn and Child Health care services in India. *Journal of Epidemiology and Global Health*, 2(4), 221–224. <https://doi.org/10.1016/j.jegh.2012.12.004>
- Rasanathan, K., Bennett, S., Atkins, V., Beschel, R., Carrasquilla, G., Charles, J., Dasgupta, R., Emerson, K., Glandon, D., Kanchanachitra, C., Kingsley, P., Matheson, D., Mbabu, R. M., Mwansambo, C., Myers, M., Paul, J., Radebe, T., Smith, J., Solar, O., ... Zaidi, S. (2017). Governing multisectoral action for health in low- and middle-income countries. *PLoS Medicine*, 14(4), 1–9. <https://doi.org/10.1371/journal.pmed.1002285>
- Rasanathan, K., Damji, N., Atsbeha, T., Brune Drisse, M. N., Davis, A., Dora, C., Karam, A., Kuruvilla, S., Mahon, J., Neira, M., Villar Montesinos, E., von Zinkernagel, D., & Webb, D. (2015). Ensuring multisectoral action on the determinants of reproductive, maternal, newborn, child, and adolescent health in the post-2015 era. *British Medical Journal*, 351(Suppl.1), h4213. <https://doi.org/10.1136/bmj.h4213>
- Reeve, C., Humphreys, J., & Wakerman, J. (2015). A comprehensive health service evaluation and monitoring framework. *Evaluation and Program Planning*, 53, 91–98. <https://doi.org/10.1016/j.evalprogplan.2015.08.006>
- Rispel, L. (2016). Analysing the progress and fault lines of health sector transformation in

- South Africa. In A. Paradath, J. King, E. Mackie, & J. Casciola (Eds.), *South African Health Review* (pp. 17–24). Health Systems Trust.
<https://www.hst.org.za/publications/South African Health Reviews/SAHR 2016.pdf>
- Rispel, L., & Nieuwoudt, S. (2013). Mainstreaming the Social Determinants of Health in South Africa: Rhetoric or reality? In A. Paradath & R. English (Eds.), *South African Health Review* (pp. 89–114). <https://www.hst.org.za/publications/South African Health Reviews/SAHR 2012-2013 Full.pdf>
- Roberts, D. A., Ng, M., Ikilezi, G., Gasasira, A., Dwyer-lindgren, L., Fullman, N., Nalugwa, T., Kanya, M., & Gakidou, E. (2015). Benchmarking health system performance across regions in Uganda : a systematic analysis of levels and trends in key maternal and child health interventions , 1990 – 2011. *BMC Medicine*, *13*(285), 1–17.
<https://doi.org/10.1186/s12916-015-0518-x>
- Rogo, K. O., Oucho, J., & Mwalali, P. (2006). Maternal Mortality. In D. Jamison, R. Feachem, & M. Makgoba (Eds.), *Disease and Mortality in Sub-Saharan Africa* (2nd ed.). The World Bank. <https://www.ncbi.nlm.nih.gov/books/NBK2288/>
- Rosen, H. E., Lynam, P. F., Carr, C., Reis, V., Ricca, J., Bazant, E. S., Bartlett, L. A., Abayisenga, G., Ametepi, P., Cantor, D., Chavane, L., Currie, S., de Graft-Johnson, J., Drake, M., Getachew, A., Gomez, P., Kagema, F., Makene, C. L., Malonza, I., ... Zoungrana, J. (2015). Direct observation of respectful maternity care in five countries: A cross-sectional study of health facilities in East and Southern Africa. *BMC Pregnancy and Childbirth*, *15*(1), 1–11. <https://doi.org/10.1186/s12884-015-0728-4>
- Ross, J. A., Campbell, O. M. R., & Bulatao, R. (2001). The Maternal and Neonatal Programme Effort Index (MNPI). *Tropical Medicine and International Health*, *6*(10), 787–798.
- Roux, A. V. D. (2011). Complex systems thinking and current impasses in health disparities research. *American Journal of Public Health*, *101*(9), 1627–1634.
<https://doi.org/10.2105/AJPH.2011.300149>
- Russ, S. A., Larson, K., Tullis, E., & Halfon, N. (2013). A lifecourse approach to health development: Implications for the maternal and child health research agenda. *Maternal and Child Health Journal*, *18*(2), 497–510. <https://doi.org/10.1007/s10995-013-1284-z>
- Rwashana, A. S., Nakubulwa, S., Nakakeeto-Kijjambu, M., & Adam, T. (2014). Advancing the Application of Systems Thinking in Health. *Health Research Policy and Systems*, *12*(50), 1–5. <https://doi.org/10.1186/1478-4505-12-50>
- Saturno-Hernández, P. J., Martínez-Nicolás, I., Moreno-Zegbe, E., Fernández-Elorriaga, M., & Poblano-Verástegui, O. (2019). Indicators for monitoring maternal and neonatal quality care: A systematic review. *BMC Pregnancy and Childbirth*, *19*(1), 1–11.
<https://doi.org/10.1186/s12884-019-2173-2>
- Say, L., Chou, D., Gemmill, A., Tunçalp, O., Moller, A. B., Daniels, J., Gulmezoglu, A. M., Temmerman, M., & Alkema, L. (2014). Global causes of maternal death: A WHO systematic analysis. *The Lancet Global Health*, *2*(6), 323–333.
[https://doi.org/10.1016/S2214-109X\(14\)70227-X](https://doi.org/10.1016/S2214-109X(14)70227-X)

- Say, L., Pattinson, R. C., & Gülmezoglu, a M. (2004). WHO systematic review of maternal morbidity and mortality: the prevalence of severe acute maternal morbidity (near miss). *Reproductive Health, 1*(1), 3. <https://doi.org/10.1186/1742-4755-1-3>
- Say, L., Souza, J. P., & Pattinson, R. C. (2009). Maternal near miss - towards a standard tool for monitoring quality of maternal health care. *Best Practice and Research: Clinical Obstetrics and Gynaecology, 23*(3), 287–296. <https://doi.org/10.1016/j.bpobgyn.2009.01.007>
- Schaller, M., Hackl, W. O., & Ammenwerth, E. (2018). Improving patient safety by reusing clinical routine data-An expert survey on patient safety indicators. *Studies in Health Technology and Informatics, 248*, 300–306. <https://doi.org/10.3233/978-1-61499-858-7-300>
- Schneider, H., Besada, D., Sanders, D., Daviaud, E., & Rohde, S. (2018). Ward-based primary health care outreach teams in South Africa: developments, challenges and future directions. In L. Rispel & A. Padarath (Eds.), *South African Health Review* (pp. 59–66). Health Systems Trust. <https://www.hst.org.za/publications/South African Health Reviews/SAHR 2018.pdf>
- Schneider, H., English, R., Tabana, H., Padayachee, T., & Orgill, M. (2014). Whole-system change: case study of factors facilitating early implementation of a primary health care reform in a South African province. *BMC Health Services Research, 14*(1), 609. <https://doi.org/10.1186/s12913-014-0609-y>
- Schünemann, H., Brozek, J., Guyatt, G., & Oxman, A. (2013). Framing the Healthcare Question. In *The GRADE Handbook* (October 20). <http://gdt.guidelinedevelopment.org/app/handbook/handbook.html#h.2uab3znt2cji>
- Schutijser, B. C. F. M., Klopotowska, J. E., Jongerden, I. P., Wagner, C., & de Bruijne, M. C. (2020). Feasibility of reusing routinely recorded data to monitor the safe preparation and administration of injectable medication: A multicenter cross-sectional study. *International Journal of Medical Informatics, 141*, 104201. <https://doi.org/10.1016/j.ijmedinf.2020.104201>
- Sheikh, M. (2014). Digital health information system in Africa's resource poor countries: current challenges and opportunities. *Journal of Health Informatics in Developing Countries, 8*(1), 78–87. <https://www.jhidc.org/index.php/jhidc/article/view/118>
- Shengelia, B., Tandon, A., Adams, O. B., & Murray, C. J. L. (2005). Access, utilization, quality, and effective coverage: An integrated conceptual framework and measurement strategy. *Social Science and Medicine, 61*(1), 97–109. <https://doi.org/10.1016/j.socscimed.2004.11.055>
- Sherr, K., Fernandes, Q., Kanté, A. M., Bawah, A., Condo, J., & Mutale, W. (2017). Measuring health systems strength and its impact : experiences from the African Health Initiative. *BMC Health Services Research, 17*(Suppl 3). <https://doi.org/10.1186/s12913-017-2658-5>
- Shibanuma, A., Yeji, F., Okawa, S., Mahama, E., Kikuchi, K., Narh, C., Enuameh, Y., Nanishi, K., Oduro, A., Owusu-Agyei, S., Gyapong, M., Asare, G. Q., Yasuoka, J.,

- Ansah, E. K., Hodgson, A., & Jimba, M. (2018). The coverage of continuum of care in maternal, newborn and child health: A cross-sectional study of woman-child pairs in Ghana. *BMJ Global Health*, 3(4), 1–13. <https://doi.org/10.1136/bmjgh-2018-000786>
- Singh, K., Story, W. T., & Moran, A. C. (2016). Assessing the Continuum of Care Pathway for Maternal Health in South Asia and Sub-Saharan Africa. *Maternal and Child Health Journal*, 20(2), 281–289. <https://doi.org/10.1007/s10995-015-1827-6>
- Solar, O., & Irwin, A. (2010). *A Conceptual Framework for Action on the Social Determinants of Health*. https://www.who.int/sdhconference/resources/ConceptualframeworkforactiononSDH_eng.pdf
- Souza, J. P., Gulmezoglu, A. M., Vogel, J., Carroli, G., Lumbiganon, P., Qureshi, Z., Costa, M. J., Fawole, B., Mugerwa, Y., Nafiou, I., Neves, I., Wolomy-Molondo, J. J., Bang, H. T., Cheang, K., Chuyun, K., Jayaratne, K., Jayathilaka, C. A., Mazhar, S. B., Mori, R., ... Say, L. (2013). Moving beyond essential interventions for reduction of maternal mortality (the WHO Multicountry Survey on Maternal and Newborn Health): A cross-sectional study. *The Lancet*, 381(9879), 1747–1755. [https://doi.org/10.1016/S0140-6736\(13\)60686-8](https://doi.org/10.1016/S0140-6736(13)60686-8)
- Spencer, L., Ritchie, J., Lewis, J., & Dillon, L. (2003). *Quality in Qualitative Evaluation: A framework for assessing research evidence*. <http://www.alnap.org/resource/10033>
- Srivastava, A., Avan, B. I., Rajbangshi, P., & Bhattacharyya, S. (2015). Determinants of women's satisfaction with maternal health care: a review of literature from developing countries. *BMC Pregnancy & Childbirth*, 15(1), 97. <https://doi.org/10.1186/s12884-015-0525-0>
- Statistics South Africa. (2015). *Millennium Development Goals 5: Improve Maternal Health*. Statistics South Africa. http://www.statssa.gov.za/MDG/MDG_Goal5_report_2015_.pdf
- Statistics South Africa. (2017a). *General Household Survey: Selected Development Indicators 2016*. <https://www.statssa.gov.za/publications/P0318/P03182016.pdf>
- Statistics South Africa. (2017b). *Nesstar*. <http://interactive.statssa.gov.za:8282/webview/>
- Statistics South Africa. (2017c). *Statistics South Africa*. http://www.statssa.gov.za/?page_id=595
- Statistics South Africa. (2019). *Open Data Portal*. Data First - University of Cape Town. <https://www.datafirst.uct.ac.za/dataportal/index.php/catalog/central>
- Statistics South Africa. (2020a). *Open Data Portal: Census 2011 South Africa*. Data First - University of Cape Town. <https://www.datafirst.uct.ac.za/dataportal/index.php/catalog/485>
- Statistics South Africa. (2020b). *Open Data Portal: General Household Survey*. Data First - University of Cape Town. <https://www.datafirst.uct.ac.za/dataportal/index.php/catalog/central>
- Stern, S., Wares, A., Orzell, S., & O'Sullivan, P. (2014). *Social Progress Index 2014*:

Methodological Report.

<https://www.socialprogress.org/assets/downloads/resources/2014/2014-Social-Progress-Index-Exec-Summary.pdf>

- Sturmberg, J. P., O'Halloran, D. M., & Martin, C. M. (2012). Understanding health system reform - A complex adaptive systems perspective. *Journal of Evaluation in Clinical Practice, 18*(1), 202–208. <https://doi.org/10.1111/j.1365-2753.2011.01792.x>
- Taplin, S. H., Price, R. A., Edwards, H. M., Foster, M. K., Breslau, E. S., Chollette, V., Das, I. P., Clauser, S. B., Fennell, M. L., & Zapka, J. (2012). Introduction: Understanding and influencing multilevel factors across the cancer care continuum. *Journal of the National Cancer Institute - Monographs, 44*, 2–10. <https://doi.org/10.1093/jncimonographs/lgs008>
- Thaddeus, S., & Maine, D. (1994). Too far to walk: Maternal mortality in context. *Social Science and Medicine, 38*(8), 1091–1110. [https://doi.org/10.1016/0277-9536\(94\)90226-7](https://doi.org/10.1016/0277-9536(94)90226-7)
- The Cochrane Collaboration. (2017). *GRADE approach to evaluating the quality of evidence: a pathway | Cochrane Training*. <http://training.cochrane.org/path/grade-approach-evaluating-quality-evidence-pathway>
- Tsasis, P., Evans, J. M., & Owen, S. (2012). Reframing the challenges to integrated care : a complex-adaptive systems perspective. *International Journal of Integrated Care, 12*. <http://www.ijic.org/>
- Tunçalp, Ö, Were, W., MacLennan, C., Oladapo, O., Gülmezoglu, A., Bahl, R., Daelmans, B., Mathai, M., Say, L., Kristensen, F., Temmerman, M., & Bustreo, F. (2015). Quality of care for pregnant women and newborns-the WHO vision. *BJOG: An International Journal of Obstetrics & Gynaecology, 122*(8), 1045–1049. <https://doi.org/10.1111/1471-0528.13451>
- UN-DESA. (2017). *Sustainable Development Goal 3: Ensure healthy lives and promote well-being for all at all ages*. Sustainable Development Knowledge Platform. <https://sustainabledevelopment.un.org/sdg3>
- United Nations Development Program. (2016). Technical Notes: Calculating the Human Development Indices - Graphical Presentation. In *Human Development Report 2016*. United Nations Development Program. <https://doi.org/10.1115/1.1731317>
- Valentine, N. B., & Bonsel, G. J. (2016). Exploring models for the roles of health systems' responsiveness and social determinants in explaining universal health coverage and health outcomes. *Global Health Action, 9*(1), 29329. <https://doi.org/10.3402/gha.v9.29329>
- Valentine, N. B., Koller, T. S., & Hosseinpoor, A. R. (2016). Monitoring health determinants with an equity focus: A key role in addressing social determinants, universal health coverage, and advancing the 2030 sustainable development agenda. *Global Health Action, 9*(1), 34247. <https://doi.org/10.3402/GHA.V9.34247>
- Venkatesh, V., Brown, S. A., & Bala, H. (2013). Bridging the Qualitative-Quantitative

Divide: Guidelines for Conducting Mixed Methods Research in Information Systems. *MIS Quarterly*, 37(1), 21–54. <https://doi.org/10.25300/MISQ/2013/37.1.02>

- Victora, C. G., Barros, A. J. D., Axelson, H., Bhutta, Z. A., Chopra, M., França, G. V. A., Kerber, K., Kirkwood, B. R., Newby, H., Ronsmans, C., & Boerma, J. T. (2012). How changes in coverage affect equity in maternal and child health interventions in 35 Countdown to 2015 countries: An analysis of national surveys. *The Lancet*, 380(9848), 1149–1156. [https://doi.org/10.1016/S0140-6736\(12\)61427-5](https://doi.org/10.1016/S0140-6736(12)61427-5)
- Victora, C. G., Fenn, B., Bryce, J., & Kirkwood, B. R. (2005). Co-coverage of preventive interventions and implications for child-survival strategies: Evidence from national surveys. *Lancet*, 366(9495), 1460–1466. [https://doi.org/10.1016/S0140-6736\(05\)67599-X](https://doi.org/10.1016/S0140-6736(05)67599-X)
- Villar, J., Ba'aqeel, H., Piaggio, G., Lumbiganon, P., Belizan, J., Farnot, U., Al-Mazrou, Y., Carroli, G., Pinol, A., Donner, A., & Langer, A. (2001). WHO antenatal care randomised trial for the evaluation of a new model of routine antenatal care*. *The Lancet*, 357(9268), 1551–1564. [https://doi.org/https://doi.org/10.1016/s0140-6736\(00\)04722-x](https://doi.org/https://doi.org/10.1016/s0140-6736(00)04722-x)
- von Schrinding, Y. (2002). Intersectoral planning for health and sustainable development. In *Health in Sustainable Development Planning: The role of indicators* (pp. 69–84). World Health Organization. <https://doi.org/10.1289/ehp.116-a20>
- Wabiri, N., Chersich, M., Shisana, O., Blaauw, D., Rees, H., & Dwane, N. (2016). Growing inequities in maternal health in South Africa : a comparison of serial national household surveys. *BMC Pregnancy and Childbirth*, 16(256). <https://doi.org/10.1186/s12884-016-1048-z>
- Wabiri, N., Chersich, M., Zuma, K., Blaauw, D., Goudge, J., & Dwane, N. (2013). Equity in maternal health in South Africa: analysis of health service access and health status in a national household survey. *PloS One*, 8(9), e73864. <https://doi.org/10.1371/journal.pone.0073864>
- Walsh, D., Rm, M. A., Senior, D., & Downe, S. (2006). Appraising the quality of qualitative research. *Midwifery*, 22, 108–119. <https://doi.org/10.1016/j.midw.2005.05.004>
- Wang, W., & Hong, R. (2015). Levels and determinants of continuum of care for maternal and newborn health in Cambodia- evidence from a population-based survey. *BMC Pregnancy & Childbirth*, 15(62), 1–10. <https://doi.org/10.1186/s12884-015-0497-0>
- Wehrmeister, F. C., Restrepo-mendez, M., Franca, V. A., & Victora, G. (2016). Summary indices for monitoring universal coverage in maternal and child health care. *Bulletin of the World Health Organization*, 94(November), 903–912. <https://doi.org/http://dx.doi.org/10.2471/BLT.16.173138>
- WenJuan, W., & Hong, R. (2013). *Completing the continuum of care for maternal and newborn health in Cambodia: who drops out? DHS Further Analysis Reports No. 85*. <https://dhsprogram.com/pubs/pdf/FA85/FA85.pdf>
- Williams, M., & Dyer, W. (2017). Complex realism in social research. *Methodological*

- Innovations*, 10(2), 205979911668356. <https://doi.org/10.1177/2059799116683564>
- Wilunda, C., Putoto, G., Riva, D. D., & Manenti, F. (2015). Assessing Coverage , Equity and Quality Gaps in Maternal and Neonatal Care in Sub- Saharan Africa : An Integrated Approach. *PLoS ONE*, 10(5), 1–16. <https://doi.org/10.1371/journal.pone.0127827>
- World Health Organization (WHO). (2009). *Integrated Management of Pregnancy and Childbirth. WHO Recommended Interventions for Improving Maternal and Newborn Health*. 1–6. <https://doi.org/WHO/MPS/07.05>
- World Health Organization (WHO). (2011). *Closing the gap: policy into practice for social determinants of health*. WHO. <https://www.who.int/sdhconference/Discussion-Paper-EN.pdf?ua=1>
- World Health Organization (WHO). (2014a). *A Policy Guide for Implementing Essential Interventions for Reproductive, Maternal, Newborn and Child Health (RMNCH): A Multisectoral Policy Compendium for RMNCH*. 1–56. http://www.who.int/pmnch/knowledge/publications/policy_compendium.pdf?ua=1
- World Health Organization (WHO). (2014b). *Fulfilling the Health Agenda for Women and Children*. https://data.unicef.org/wp-content/uploads/2015/12/Countdown_to_2015-Fulfilling-the-Health_Agenda_for_Women_and_Children-The_2014_Report-Conference_Draft_159.pdf
- World Health Organization (WHO). (2016a). *Country Data, Universal Accountability: Monitoring Priorities for the Global Strategy for Women’s, Children’s and Adolescents’ Health (2016-2030)*. <https://doi.org/10.1017/CBO9781107415324.004>
- World Health Organization (WHO). (2016b). *Maternal health*. World Health Organization. http://www.who.int/topics/maternal_health/en/
- World Health Organization (WHO). (2016c). *Standards for improving quality of maternal and newborn care in health facilities*. https://www.who.int/docs/default-source/mca-documents/advisory-groups/quality-of-care/standards-for-improving-quality-of-maternal-and-newborn-care-in-health-facilities.pdf?sfvrsn=3b364d8_2
- World Health Organization (WHO). (2018a). *Intrapartum care for a positive childbirth experience WHO recommendations*. <https://www.who.int/reproductivehealth/publications/intrapartum-care-guidelines/en/>
- World Health Organization (WHO). (2018b). *Intrapartum care for a positive childbirth experience WHO recommendations*. <https://www.who.int/reproductivehealth/publications/intrapartum-care-guidelines/en/>
- World Health Organization (WHO). (2005a). *The World Health Report 2005: Make Every Mother and Child Count*. <http://www.who.int/whr/2005/en/>
- World Health Organization (WHO). (2005b). *The World Health Report 2005: Make Every Mother and Child Count*. <https://www.who.int/whr/2005/en/>
- World Health Organization (WHO). (2018). *Quality, Equity, Dignity: The network to improve quality of care for maternal, newborn and child health*.

<https://apps.who.int/iris/bitstream/handle/10665/272612/9789241513951-eng.pdf?ua=1>

- World Health Organization (WHO), & Department of Reproductive Health and Research. (2014). *Targets and Strategies for Ending Preventable Maternal Mortality: Consensus Statement*.
https://apps.who.int/iris/bitstream/handle/10665/130776/WHO_RHR_14.21_eng.pdf?sequence=1
- World Health Organization (WHO), & International Center for Equity in Health. (2015). *State of inequality: reproductive, maternal and child health*.
https://www.who.int/docs/default-source/gho-documents/health-equity/state-of-inequality/state-of-inequality-reproductive-maternal-new-born-and-child-health.pdf?sfvrsn=f4034289_2
- Wright, G., O'Mahony, D., & Cilliers, L. (2017). Electronic health information systems for public health care in South Africa: A review of current operational systems. *Journal of Health Informatics in Africa*, 4(1), 51–57. <https://doi.org/10.12856/JHIA-2017-v4-i1-164>
- Wude, H., Woldie, M., Melese, D., Lolaso, T., & Balcha, B. (2020). Utilization of routine health information and associated factors among health workers in Hadiya Zone, Southern Ethiopia. *PLoS ONE*, 15(5), 1–11.
<https://doi.org/10.1371/journal.pone.0233092>
- Yeji, F., Shibamura, A., Oduro, A., Debpuur, C., Kikuchi, K., Owusu-Agei, S., Gyapong, M., Okawa, S., Ansah, E., Asare, G. Q., Nanishi, K., Williams, J., Addei, S., Tawiah, C., Yasuoka, J., Enuameh, Y., Sakeah, E., Wontuo, P., Jimba, M., ... Kamiya, Y. (2015). Continuum of Care in a Maternal, Newborn and Child Health Program in Ghana: Low Completion Rate and Multiple Obstacle Factors. *PLoS ONE*, 10(12), 1–24.
<https://doi.org/10.1371/journal.pone.0142849>
- Zachariadis, M., Scott, S., & Barrett, M. (2013a). Methodological implications of critical realism for mixed-methods research. *MIS Quarterly*, 37(3), 856–879.
<https://www.jstor.org/stable/43826004?seq=1>
- Zachariadis, M., Scott, S., & Barrett, M. (2013b). Methodological implications of critical realism for mixed-methods research. *MIS Quarterly*, 37(3), 855–880.
<https://doi.org/10.25300/misq/2013/37.3.09>

Tables and Figures

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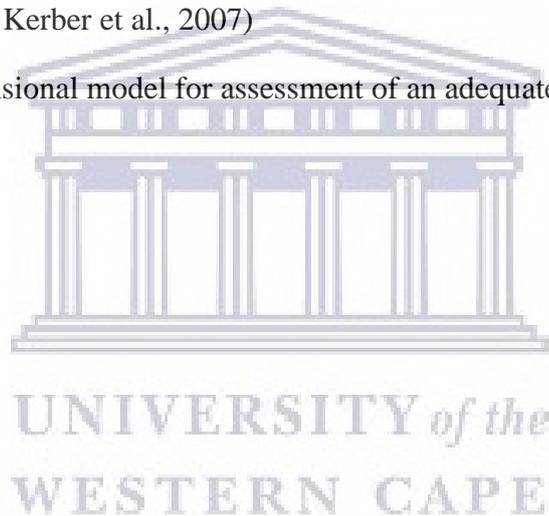
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Appendices

I. Chapter Appendices

Chapter 3

Appendix 1 The quality assessment criteria for studies selected into the review

Study Design	Quality Area	Essential Criteria	Key Indicators/Questions	Scoring
Qualitative and Quantitative	<i>Findings/Results</i>	<ul style="list-style-type: none"> ➤ Credibility <ul style="list-style-type: none"> ○ Expansion of knowledge ▪ Generalizability/ inferences explained 	<ul style="list-style-type: none"> ➤ Findings/conclusions ‘make sense’/have a coherent logic ○ Findings presented or conceptualized in a way that offers new insights/alternative ways of thinking ○ Discussion of limitations of evidence <ul style="list-style-type: none"> ▪ Discussion of what can be generalised to wider population OR description of the contexts in which the study was conducted to allow applicability to other settings/contextual generalities to be assessed 	3
	<i>Design and Sampling</i>	<ul style="list-style-type: none"> ▪ Method/design consistent with research intent ➤ Sample and sampling method appropriate ○ Data collection strategy apparent and appropriate 	<ul style="list-style-type: none"> ▪ Rationale explored for specific method ▪ Use of different features of design evident in findings presented ▪ Discussion of limitations of design and their implications for the study evidence ➤ Description of how sampling was undertaken ➤ Justification for the sampling strategy provided ○ Description of how data was collected ○ Methods appropriate for type of data required. 	3

Study Design	Quality Area	Essential Criteria	Key Indicators/Questions	Scoring
	<i>Analysis</i>	<ul style="list-style-type: none"> ▪ Approach to analysis conveyed well ○ Analytical approach appropriate 	<ul style="list-style-type: none"> ▪ Clear rationale for choice of data management method/tool/package ○ Analytical approach appropriate for the method chosen ○ Discussion of how coding systems/conceptual frameworks evolved (qualitative) 	2
	<i>Reporting/ Interpretation</i>	<ul style="list-style-type: none"> ➤ How clear and coherent is the reporting? ○ Link between data, interpretation and conclusions clear 	<ul style="list-style-type: none"> ➤ Key messages highlighted or summarized ○ Discussion of how explanations/theories/conclusions were derived 	2
	<i>Ethics</i>	<ul style="list-style-type: none"> ▪ Demonstration of sensitivity to ethical concerns 	<ul style="list-style-type: none"> ▪ Informed Consent ▪ Confidentiality of data, respect/protection of participants including anonymity ▪ Ethical committee approval 	1
Qualitative (additional)	<i>Reflexivity & Neutrality</i>	<ul style="list-style-type: none"> ○ Assumptions that shape the output of the evaluation clear 	<ul style="list-style-type: none"> ○ Discussion/evidence of the main assumptions/hypotheses/theoretical ideas on which the evaluation was based ○ Evidence of openness to new/alternative ways of viewing subject/theories/assumptions ○ Discussion of how error or bias may have arisen in design/data collection/analysis and how addressed, if at all ○ Reflections on the impact of the researcher on the research process 	1
Quantitative (additional)	<i>Risk of Bias</i>	<ul style="list-style-type: none"> ▪ Measures to reduce bias in RCT <p>OR</p> <ul style="list-style-type: none"> ➤ Measures to reduce bias in 	<ul style="list-style-type: none"> ▪ Allocation concealment ▪ Blinding ▪ Complete accounting of participants and outcomes ▪ Non-selective outcome reporting 	1

Study Design	Quality Area	Essential Criteria	Key Indicators/Questions	Scoring
		observational studies	<ul style="list-style-type: none"> ▪ Use of validated outcome measures OR <ul style="list-style-type: none"> ➤ Appropriateness of eligibility criteria ➤ Sound/non-differential measurement of exposure and outcome among populations of interest ➤ Description, measurement and control of confounding ➤ Adequate follow up of both cases and control ➤ Discussion of how error or bias may have arisen in design/data collection/analysis and how addressed, if at all 	
			Total Maximum Points (Qualitative)	12
			Total Maximum Points (Quantitative)	12
			Total Maximum Points (Mixed)	13

Appendix 2 Tool used to extract data from the articles selected in the critical interpretive synthesis

<i>Citation:</i>	
<i>Country:</i>	
<i>Aims of the Study</i>	
<i>Ethics – how ethical issues were addressed:</i>	
<i>Study setting:</i>	
<i>Theoretical background of study:</i>	
<i>Sampling approach:</i>	
<i>Participant characteristics:</i>	
<i>Data collection methods:</i>	
<i>Data analysis approach:</i>	
<i>Number and types continuum indicators:</i>	
<i>Key themes/indicators/models identified in the study</i>	

<i>Findings/Data extracts related to the key themes:</i>	
<i>Author explanations of the key themes/indicators/models</i>	
<i>Methodological and Conceptual recommendations made by authors:</i>	
<i>Reviewer Interpretation</i>	
<i>Assessment of study quality (rating from Table 1): include score and specific remarks on study quality</i>	

Based on

1. Munro S, Lewin S, Smith H, Engel M, Fretheim A, Volmink J. (2007) *Adherence to tuberculosis treatment: a qualitative systematic review of stakeholder perceptions*. PLOS Medicine. 4(7): e238

2. Noyes J & Lewin S. Chapter 5: Extracting qualitative evidence. In: Noyes J, Booth A, Hannes K, Harden A, Harris J, Lewin S, Lockwood C (editors), *Supplementary Guidance for Inclusion of Qualitative Research in Cochrane Systematic Reviews of Interventions*. Version 1 (updated August 2011). Cochrane Collaboration Qualitative Methods Group, 2011. Available from URL <http://cqrmg.cochrane.org/supplemental-handbook-guidance>

Appendix 3. Summary of main findings, methodology and metrics/ indicators identified among all the articles reviewed.

Citation	Main Findings	Methods	Continuum of Care Metrics/Indicators
[1]	Measurement of coverage along the continuum of care (COC) for maternal, newborn and child health (MNCH) should be conducted using complementary data sources, and should include measurement of quality.	Qualitative review of literature	Studies reviewed focused on different indicators around Antenatal Care (ANC), birth interventions, vaccination, treatment of childhood illnesses
[2]	A customized COC model for MNCH in Nepal is feasible	Review of literature and consultations with experts in the country.	Contraceptive Prevalence Rate (CPR), ANC, Tetanus for pregnant woman, Delivery at health institution, Skilled birth attendance (SBA), Exclusive breastfeeding, Measles immunization, Antibiotics for suspected pneumonia, Oral Rehydration Therapy (ORT) for under 5 years old diarrhoea case
[3]	A population level framework can be defined that outlines integrated service delivery packages along the COC for MNCH	Qualitative review of literature	No indicators but a framework of general packages of interventions including family/community care, reproductive health, ANC childbirth care, PNC, newborn and child care, and child health.

Citation	Main Findings	Methods	Continuum of Care Metrics/Indicators
[4]	Two different indices for coverage along the MNCH continuum are correlated with each other and some child and neonatal outcomes.	Quantitative analysis of coverage and correlations; stratifications by wealth quintiles.	Co-coverage Index (8 preventive interventions for mother and child: ANC, tetanus during pregnancy, SBA, vaccinations and supplements for child, access to improved drinking water) Composite Coverage Index: family planning, SBA, vaccinations for child, ORT for diarrhea, and care seeking for pneumonia.
[5]	There were district gaps in MNCH coverage measured using the Coverage Gap Index (CGI). Areas with high gaps (>=50%) identified.	Use of household and facility survey data to calculate the (CGI) in Indian districts	CPR, SBA, ANC, Immunizations (measles; Diphtheria, pertussis and tetanus; BCG), ORT, Treatment for Acute Respiratory Infections (ARI)
[6]	Quality in emergency obstetric (EmOC) and newborn care (EmNC) was low in a sample of health facilities in Ghana. Facilities performed slightly better on routine signal functions.	Health facility assessment; quantitative analysis of effective coverage and composite quality measures.	Many signal functions of Routine Delivery Care, EmOC and EmNC basic and comprehensive functions; as well as non-medical aspects of quality (mainly hygienic toilet conditions)
[7]	193 indicators developed for routine information systems to monitor WHO essential interventions for RMNCH. Household surveys not sufficient.	Indicators derived from surveys and routine information systems, and evaluated by panel of experts.	Framework of 193 indicators across 45 WHO Essential Interventions from preconception to newborn care.
[8]	Differences in quality EmOC and EmNC performance among hospitals and health facilities in three African countries. High access and low quality of care concomitant.	Facility quality and coverage assessment tools; calculation of indicators.	Availability of EmOC and EmNC facilities, fatality rates, and performance of Caesareans; Equity indicators; Multi-dimensional quality indicators.
[9]	Creation of a quality index from demographic and health survey (DHS) data is feasible. The index is associated with disparities in quality of care by wealth and geographical location.	Used WHO guidelines to identify indicators. Created composite indices using statistical methods. Explored association with equity markers.	ANC visits, signal functions during ANC, supplementation and immunizations during pregnancy, discussion about birth preparedness and recognition of danger signs, signal functions for newborn and postnatal checks.
[10]	There are many frameworks for assessing quality of care and provider competency, organizational factors and women's perspectives should all be considered in monitoring.	Narrative review of current quality frameworks	Core essential interventions for childbirth and postnatal care (PNC) for mother and newborn, women's experience of care, provider competency.

Citation	Main Findings	Methods	Continuum of Care Metrics/Indicators
[11]	When the content of care is measured, coverage of high quality contacts was consistently lower than crude coverage among facilities in three low and middle income countries (LMICs).	Households and frontline health worker surveys to estimate coverage by specific interventions	8 criteria of routine processes performed during ANC visit; 2 criteria for prevention of haemorrhage during SBA; 5 criteria for post-partum care; 5 criteria for PNC.
[12]	Moderate improvements in COC coverage indicators in a program intervention area in Nigeria.	Random sample of households in intervention area interviewed at baseline and follow up.	Demand for family planning (FP), ANC, SBA, PNC for mother and baby, exclusive breastfeeding, vaccination for DPT3, and antibiotics for pneumonia.
[13]	Testing a model of the MNCH COC in community settings in Ghana.	A cluster randomized controlled trial design to measure effectiveness and implementation outcomes	COC completion, PNC care delivered, complications, perinatal and neonatal mortality, coverage of interventions, costs and sustainability.
[14]	Coverage targets were low for MNCH COC interventions nationally and sub-nationally in Nigeria. Intervention improved coverage some.	LQAS methodology to sample study areas. Composite coverage rates estimated per study area.	Demand for FP, ANC, SBA, PNC, exclusive breastfeeding, DPT3, and antibiotics for pneumonia .
[15]	Coverage of interventions along the MCH continuum differed across subnational levels, with urban/rural disparities also observed.	Estimated indicators by statistical models using household, administrative and census data.	Health outcomes; MCH interventions – ANC, tetanus, SBA, Breastfeeding, ORS, care for ARI; Socioeconomic factors – housing, electricity, sanitation, water, education
[16]	Use of one COC level influences progression to another. Socioeconomic indicators also influence use of the COC services.	Descriptive and regression analysis methods on DHS data.	ANC one or four visits, SBA, PNC as well as family planning counseling within year of birth.
[17]	A majority of women in Nigeria dropped out of the COC from ANC to PNC due to socio-economic issues and lack of access to facilities.	Descriptive and regression analysis methods on DHS data.	ANC, SBA, PNC.
[18]	Positive associations from one adequate level of care to another. Low utilization of some levels of the MNCH COC in a number of Sub-Saharan Africa countries.	Structural equation modeling of relationships in the COC.	Child immunization, PNC for mother and baby, delivery care (including caesarean services and SBA), ANC (including specific signal functions). Various individual and community factors as determinants of utilization.
[19]	Regional variations in utilization of different stages of the MCH COC in Cambodia	Descriptive statistics. Regression models to assess factors that	ANC, SBA and PNC and their independent determinants.

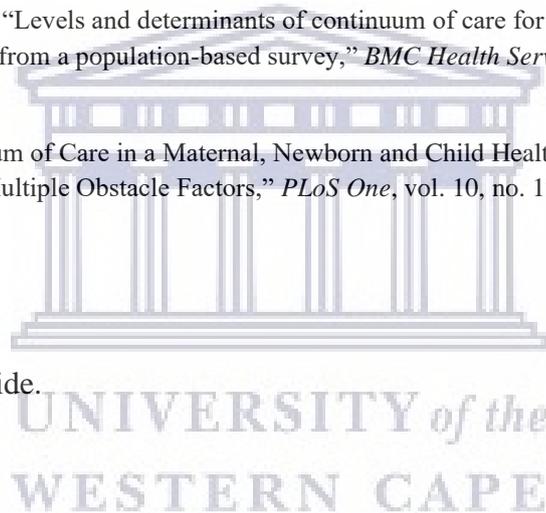
Citation	Main Findings	Methods	Continuum of Care Metrics/Indicators
		affect use of COC services.	
[20]	COC completion rates were low in Ghana, with various factors affecting utilization.	Descriptive statistics and multiple logistic regression models.	ANC, SBA and PNC and their independent determinants

- [1] J. Bryce, F. Arnold, A. Blanc, A. Hancioglu, H. Newby, and J. Requejo, "Measuring Coverage in MNCH : New Findings , New Strategies , and Recommendations for Action," *PLoS Med.*, vol. 10, no. 5, 2013.
- [2] K. Ashish *et al.*, "State of maternal , newborn and child health programmes in Nepal : what may a continuum of care model mean for more effective and efficient service delivery?," *J. Nepal Heal. Res. Counc.*, no. March 2015, 2011.
- [3] K. J. Kerber, J. E. de Graft-Johnson, Z. A. Bhutta, P. Okong, A. Starrs, and J. E. Lawn, "Continuum of care for maternal, newborn, and child health: from slogan to service delivery," *Lancet*, vol. 370, no. 9595, pp. 1358–1369, 2007.
- [4] F. C. Wehrmeister, M. Restrepo-mendez, V. A. Franca, and G. Victora, "Summary indices for monitoring universal coverage in maternal and child health care," *Bull. World Health Organ.*, vol. 94, no. November, pp. 903–912, 2016.
- [5] R. K. Rai, C. Kumar, and P. K. Singh, "District level coverage gap in Maternal, Newborn and Child Health care services in India," *J. Epidemiol. Glob. Health*, vol. 2, no. 4, pp. 221–224, 2012.
- [6] R. C. Nesbitt *et al.*, "Quality along the Continuum : A Health Facility Assessment of Intrapartum and Postnatal Care in Ghana," *PLoS One*, vol. 8, no. 11, pp. 1–11, 2013.
- [7] V. Flenady *et al.*, "eRegistries : indicators for the WHO Essential Interventions for reproductive , maternal , newborn and child health," *BMC Pregnancy Childbirth*, vol. 16, no. 293, pp. 1–15, 2016.
- [8] C. Wilunda, G. Putoto, D. D. Riva, and F. Manenti, "Assessing Coverage , Equity and Quality Gaps in Maternal and Neonatal Care in Sub- Saharan Africa : An Integrated Approach," *PLoS One*, vol. 10, no. 5, pp. 1–16, 2015.
- [9] Z. Dettrick, H. N. Gouda, A. Hodge, and E. Jimenez-Soto, "Measuring quality of maternal and newborn care in developing countries using demographic and health surveys," *PLoS One*, vol. 11, no. 6, pp. 1–21, 2016.
- [10] D. T. Lavender, "Improving quality of care during labour and childbirth and in the immediate postnatal period," *Best Pract. Res. Clin. Obstet. Gynaecol.*, vol. 36, pp. 57–67, 2016.
- [11] T. Marchant *et al.*, "Adding content to contacts: Measurement of high quality contacts for maternal and newborn health in Ethiopia, North East Nigeria, and Uttar Pradesh, India," *PLoS One*, vol. 10, no. 5, pp. 1–20, 2015.
- [12] D. Abegunde, N. Orobato, H. Sadauki, and A. Bassi, "Countdown to 2015 : Tracking Maternal and Child Health Intervention Targets Using Lot Quality Assurance Sampling in Bauchi State," pp. 1–14, 2015.

- [13] K. Kikuchi *et al.*, “Ghana’s Ensure Mothers and Babies Regular Access to Care (EMBRACE) program: study protocol for a cluster randomized controlled trial,” *Trials*, vol. 16, no. 1, p. 22, 2015.
- [14] D. Abegunde *et al.*, “Monitoring maternal, newborn, and child health interventions using lot quality assurance sampling in Sokoto State of northern Nigeria,” vol. 9716, no. April 2017, 2015.
- [15] D. A. Roberts *et al.*, “Benchmarking health system performance across regions in Uganda : a systematic analysis of levels and trends in key maternal and child health interventions , 1990 – 2011,” *BMC Med.*, vol. 13, no. 285, pp. 1–17, 2015.
- [16] K. Singh, W. T. Story, and A. C. Moran, “Assessing the Continuum of Care Pathway for Maternal Health in South Asia and Sub-Saharan Africa.,” *Matern. Child Health J.*, vol. 20, no. 2, pp. 281–9, Feb. 2016.
- [17] J. O. Akinyemi, R. F. Afolabi, and O. A. Awolude, “Patterns and determinants of dropout from maternity care continuum in Nigeria.,” *BMC Pregnancy Childbirth*, vol. 16, no. 1, p. 282, 2016.
- [18] P. O. Owili, M. Adoyo Muga, Y.-J. Chou, Y.-H. Elsa Hsu, N. Huang, and L.-Y. Chien, “Associations in the continuum of care for maternal, newborn and child health: a population-based study of 12 sub-Saharan Africa countries,” *BMC Public Health*, vol. 16, pp. 1–15, 2016.
- [19] W. Wang and R. Hong, “Levels and determinants of continuum of care for maternal and newborn health in Cambodia- evidence from a population-based survey,” *BMC Health Serv. Res.*, vol. 15, no. 62, pp. 1–9, 2015.
- [20] F. Yeji *et al.*, “Continuum of Care in a Maternal, Newborn and Child Health Program in Ghana: Low Completion Rate and Multiple Obstacle Factors,” *PLoS One*, vol. 10, no. 12, pp. 1–24, 2015.

Chapter 5

Appendix 1. Interview guide.





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INTERVIEW GUIDE

Continuum of care is defined as:

“...access to care provided by families and communities, by outpatient and outreach services, and by clinical services throughout the lifecycle, including adolescence, pregnancy, childbirth, the postnatal period, and childhood. Saving lives depends on high coverage and quality of integrated service-delivery packages throughout the continuum, with functional linkages between levels of care in the health system and between service-delivery packages, so that the care provided at each time and place contributes to the effectiveness of all the linked packages”¹

The continuum of care is endorsed by the WHO and related bodies, as well as national governments including South Africa, as an important strategy to achieve maternal, neonatal and child health outcomes in particular. It is achieved by packages of interventions across the lifecycle and also includes the social determinants of health. Our research project aims to explore the measurement dimensions of the framework and identify useful, reliable indicators for the South African context. To do so we assessed health information system resources, particularly the DHIS and National Indicator Data Set for indicators relevant to maternal health services. We also assessed the annual General Household survey for indicators relevant to social determinants of health – or the intersectoral factors of housing, water and sanitation, empowerment, nutrition and education.

To gain deeper understanding of the concept of continuum of care for maternal health we conducted a systematic review¹², focusing primarily on how it is defined and measured in low and middle income country contexts. Our synthesis of evidence revealed that there was a need for adequacy measurement on the continuum of care. Adequacy measures coverage of interventions, quality of care indicators (or proxies), incorporates social determinants of health indicators, and is also concerned about timeliness and linkages of care levels. In contrast, current measures used in research focus on coverage only, or effective coverage of limited set of interventions, no integration of SDH, and no exploration of the linkages of care indicators.

In the South African indicator framework we propose (attached in Appendix 1, with detailed descriptions of individual indicators in Appendix 2) [for manuscript, these are

¹ Kerber, K.J. et al., 2007. Continuum of care for maternal, newborn, and child health: from slogan to service delivery. *Lancet*, 370(9595), pp.1358–1369.

² Mothupi, M., Knight, L. & Tabana, H., 2018. Measurement approaches in continuum of care for maternal health: a critical interpretive synthesis of evidence from LMICs and its implications for the South African context. *BMC Health Services Research*, 18(539), pp.1–9.



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summarized as Table 1], based on currently available indicators from the DHIS and the GHS, we outline the set of indicators that can be used to monitor maternal health related performance by the health system and other sectors. In this study we focus on maternal health to demonstrate a case for measurement of a comprehensive set of indicators, and we recognize that maternal and child health should always be integrated. The set of indicators can ultimately be used to create a composite index that makes it easy to compare performance across districts/provinces.

1.

The indicator framework (Appendix 1) can be related to other indicators of performance/ access to care in the health system, because it consists of already existing indicators. However it is also multisectoral in nature, in that it includes indicators related to social determinants of health. As a collective framework it repurposes current DHIS/NIDS indicators and GHS indicators for the purpose monitoring of maternal care access across a range of relevant sectors. However, it is a hypothetical framework. We need to think about the real world implications of it, as well as similar frameworks, for future multisectoral work to improve health outcomes.

Question 1: In the era of the SDGs and focus on wider determinants of health, what do you think is the role of frameworks that integrate health system and inputs from other sectors for monitoring healthcare and outcomes in South Africa, if any?

For non-health sectors:

Question 1b: In your perspective, what is your department's role in collaboration with Department of Health to provide a continuum of care for maternal health in South Africa?

Question 1c: In what other ways is your department currently collaborating with health department if at all?

2.

Question 2a: What do you think would be the strengths of using {Indicator X} for maternal health continuum of care domain {Y} specifically?

Question 2b: What do you think would be the weakness of using {Indicator X} for maternal health continuum of care domain {Y} specifically?

Question 2c: Which other domains do you think can be added to the framework?



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Question 2d: Related to domains, which other indicators do you think are missing from the framework?

Specific indicator(s) and domain(s) depend on expertise of the respondent.

3.

The existing indicator gaps identified in the framework, as a result of lack of available data, affect the overall validity of the framework. This is particularly true for future use of indicators; if indicators are used to together formulate summary measures that can be used monitor health system performance and assess relationship with maternal health outcomes/trajectories.

Question 3: What practical steps would you recommend for the health system to address the existing indicator availability gaps as reported on the framework?

4.

Social determinants of health (SDH) are stated as one of the “critical success factors “ in the Strategic Plan for Maternal, Newborn, Child and Women’s Health and Nutrition. In our study we regard SDH indicators are an important part of a comprehensive framework for monitoring continuum of care for maternal health. The domains for SDH were set in earlier conceptual work by DOH and partners, although specific indicators were not specified/published. For the adequacy framework we sourced indicators from reliable national data sources, particularly the annual General Household Survey. These indicators imply the need for information from a diverse set of sectors, and the GHS has the benefit of being one central source of reliable information.

Question 4a: If social determinants of health are acknowledged as important, what in your view would constitute meaningful engagement of the health system with other sectors to address these?

Question 4b. What do you think the framework adds that the health system does not currently have in terms comprehensive monitoring indicators for maternal health?

Question 4c. What are the potential challenges of implementing frameworks that have both health and non-health sector indicators such as the current one?

Question 4d. To what extent can the framework in Appendix 1 be applied to intersectoral collaboration?

5. Do you have any questions/comments/concerns regarding the interview and/or the content we discussed

Chapter 6

S 1 Table. Indicators used for measurement of the continuum of care index in North West province and districts 2013-2017

	Indicators	Definition	Source
1	Cervical cancer screening coverage	Cervical smears in women 20 years and older as a proportion of the target for cervical cancer screening. According to the SA National HIV survey 2012, 20.6% (used 20% in calculations) of females over 20 years of age are HIV-positive. These women must be screened for cervical cancer every 3 years. The other 80% must still be screened every 10 years.	NIDS
2	Antenatal 1st visit before 20 weeks rate	Women who have a booking visit (first visit) before they are 20 weeks into their pregnancy as proportion of all antenatal 1st visits	NIDS
3	Antenatal 1st visit coverage	The proportion of potential antenatal clients coming for at least one (booking) antenatal visit. The census number of children under one year factorised by 1.15 is used as a proxy denominator - the extra 0.15 (15%) is a rough estimate to cater for late miscarriages (~10 to 26 w), stillbirths (after 26 weeks gestation) and infant 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	NIDS
4	Syphilis positive pregnant female receive Benz-penicillin 1st dose rate	Syphilis positive pregnant females who received Benz-penicillin 1st dose as a proportion of pregnant females who tested positive for syphilis	DHIS
5	Syphilis positive pregnant female receive Benz-penicillin 2nd dose rate	Syphilis positive pregnant female receive Benz-penicillin 2nd dose as a proportion of pregnant females who tested positive for syphilis	DHIS
6	Syphilis positive pregnant female receive Benz-penicillin 3rd dose rate	Syphilis positive pregnant female receive Benz-penicillin 3rd dose as a proportion of pregnant females who tested positive for syphilis	DHIS
7	Antenatal client start on ART rate	Antenatal clients who started on ART as a proportion of the total number of antenatal clients who are HIV positive and not previously on ART	
8	Delivery in facility rate	Deliveries in health facilities as proportion of expected deliveries in the population. Expected deliveries are estimated as population under 1 year multiplied by 1.025 to compensate for still births and infant mortality	NIDS
9	Delivery by caesarean section rate	Delivery by Caesarean section as proportion of total deliveries in health facilities	NIDS
10	Mother postnatal visit within 6 days rate	Mothers who received postnatal care within 6 days after delivery as proportion of deliveries in health facilities	NIDS
11	Couple year protection rate	Women protected against pregnancy by using modern contraceptive methods, including sterilisations, as proportion of female population 15-49 years.	NIDS
12	Termination of pregnancy 0-12 weeks rate	Pregnancies terminated in health facilities in the first 12 weeks of pregnancy as a proportion of total termination of pregnancies	NIDS

	Indicators	Definition	Source
13	Antenatal client HIV re-test rate: retesting among positive HIV clients	Antenatal clients re-tested for HIV as proportion of antenatal clients tested negative for 1st HIV tests done during current pregnancy	NIDS
14	Average Ideal Clinic status (score)	We calculated the average Ideal Clinic score across facilities in a district or province, Ideal Clinic status is a score of 70% or more on assessment of the facility readiness to provide good quality of care along the following main dimensions 1. Administration 2. Integrated Clinical Services Management 3. Medicines, Supplies and Laboratory Services 4. Human Resources for Health 5. Support Services 6. Infrastructure 7. Health Information Management 8. Communication 9. District Health System Support 10. Implementing Partners and Stakeholders.	NIDS
15	Rural obstetric response under 40 minutes rate	Primary Obstetric calls responded to under 40 minutes in a rural area as a proportion of EMS (Emergency medical services) P1 rural obstetric calls total	NIDS
16	Urban obstetric response under 15 minutes rate	Primary Obstetric calls responded to under 15 minutes in an urban area as a proportion of EMS P1 urban obstetric calls total	NIDS
17	Domestic water compliance rate	Domestic bacteriological and chemical water samples taken from Water Services Authorities and water service intermediaries at a point of use that conform to the standards set out in SANS 241 for drinking water quality and safety as a proportion of water samples collected	NIDS
18	% women 15-49 who are literate	Proportion of women 15 - 49 who achieved grade 8 or more	GHS, CS, Census
19	% women 15-49 in households with adequate water infrastructure	Proportion of women 15-49 in households with adequate water supply infrastructure	GHS, CS, Census
20	% women 15 -49 with basic sanitation facility	Proportion of women 15-49 in households with basic sanitation facilities	GHS,CS, Census
21	% women 15-49 with access to electricity	Proportion of women 15-49 in households with access to electricity	GHS, CS, Census ^a
22	% women 15-49 living in adequate housing	Proportion of women 15-49 living in households with “good” or “very good” wall, roof, and floor condition of the dwelling.	GHS
23	% women 15-49 living in formal housing	Proportion of women 15-49 in housing classified as formal housing (by Regional Development Plan (RDP) plan	GHS,CS, Census
24	% women 15 - 49 who have adequate food access	The mean proportion of women 15-49 in households that “never” had insufficient food, run out of money for food, cut the size of meals, skip a meal, or small variety of meals.	GHS,CS
25	Household Dietary Diversity Score	The Household Dietary Diversity Score by consumption of between 0-10 food groups, in households with women 15-49 years of age	GHS,CS

GHS = General Household Survey, CS= Community Survey, Census^a = electricity access computed from source of energy for lighting

Chapter 7

Table 1. Analysis of themes and their meaning and prominence across qualitative and quantitative studies of continuum of care

Key Theme	Meaning	Prominence	Example
Systematic Review			
Select and describe/define indicators	It is important to compare and assess indicators across studies, not all continuums of care are the same	Pervasive theme as all studies had to be compared for their meaning of continuum of care, i.e. indicators used to measure it.	"The number of coverage indicators differs across studies, but consistently includes the "triad" - antenatal care visits, skilled birth attendance and post-natal care check-ups [24–31]. Other indicators are related to reproductive health, newborn and child health, as well as the intersectoral factors/social determinants of health along the continuum [25–27, 29, 32–34]" p5,(1)
Assess gaps	Indicators for quality of care, social determinants of health are not always integrated in existing measures. This has implications for how comprehensively the continuum is measured in each study. Data availability can also affect what is measurable.	Somewhat prominent theme in the study, as studies tried to integrate quality through effective coverage measures, and some social determinants such as water and sanitation. Some studies did mention limitations due to data.	"Like coverage, there was no uniform definition of effective coverage, and we observed gaps in the measurement of multiple dimensions of quality." P1 (abstract), (1)
Explore composite indexing	Because of multidimensionality and sometimes many indicators of continuum of care, it is useful to use summary/composite metrics to allow easy analysis and interpretation.	Partial. Many studies assessed individual indicators, or the cascade of the continuum. Some used indexes to summarize performance and make comparisons over time and geographical areas.	"The studies in this review measured quality through a detailed assessment of sets of often numerous indicators [36, 40], or through composite metrics such as effective coverage and the Quality Index [35, 37]. These quality metrics focused on content of care and, to a lesser extent, its "context". p7,(1).
define conceptual model for measurement	Measurement gaps in this study informed an analytical framework that conceptualized comprehensive/multidimensional measurement of the continuum of care	Not prominent. It is an emerging construct from the themes analysed in the study.	The analytical approach was defined as "Measurement of timely access to evidence based interventions encompassed by the continuum of care service provision framework for maternal and child health, through a positive experience of care and within a supportive

Key Theme	Meaning	Prominence	Example
			<i>structural context that ensures good quality of care (i.e. competent human resources, actionable information systems, functional referral systems and essential physical resources)”p6, (1)</i>
Indicator Tool Development			
<i>Select and describe/define indicators</i>	<i>Conduct a systematic process of identifying indicators and prescribe a criteria for their selection and evaluation</i>	<i>Prominent theme of study – the process is the outcome.</i>	<i>“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“(2)</i>
<i>Assess gaps</i>	<i>Assess each indicator for how well it measures an intervention and characterize the gaps that remain. This process is consultative (among researchers and/or with experts/stakeholders) and also relies on existing evidence for how best to monitor specific interventions.</i>	<i>Prominent. Gaps are important to describe the nature of assessment that can be made about the continuum of care within a given context.</i>	<i>“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 an outstanding gap in linkages between one intervention package and another, which is also an important determinant of maternal health outcomes(3,4).“(2)</i>
<i>Validity considerations</i>	<i>Assess the extent to which indicators adequately measure an intervention as well as evidence on the relationship of indicators with maternal health outcomes.</i>	<i>Somewhat prominent. Validity assessment is integrated with analysis of indicator gaps. It is one of the basis for justification and inclusion of indicators in the analytical tool.</i>	<i>“Sometimes indicators are available that do not directly tie to maternal health outcomes. ... proxies such as food fortification compliance rates (Indicator 3) used by the health system used by the health system at community level. Other proxies in the figure 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“(2)</i>
<i>Systematic challenges to measurement</i>	<i>Health information system improvements that need to be made to</i>	<i>Not very prominent. The study focused on availability/non-</i>	<i>“Monitoring of new health system interventions, such as Human Papillomavirus (HPV)</i>

Key Theme	Meaning	Prominence	Example
	<i>integrate the missing indicators. Sometimes indicators are available, just not in accessible, routine systems.</i>	<i>availability of indicators, and some contextual knowledge of parallel health information system and the indicators contained therein.</i>	<i>vaccinations for school going girls and health promotion through mobile phones (MomConnect program), should be integrated into the DHIS. This will improve the comprehensiveness of the data set and ease of monitoring the continuum of care in the health system.”(2)</i>
Indexing and Performance Measurement			
<i>Define conceptual model</i>	<i>Explains the role of theory in the development of summary metrics for the continuum of care. The framework for development of the index is the adequacy framework</i>	<i>Very prominent. The conceptual/analytical framework is the basis of the analytical tools or formulas used to measure the index; it is also used in assessment of indicators that make up the index.</i>	<i>“The index was multidimensional, based on the recommended adequacy approach for measurement of the continuum of care (23).”</i>
<i>Systematic challenges to measurement</i>	<i>Unavailability of data for some of the indicators suggested by the indicator tool. Also some observed possible data quality issues.</i>	<i>Somewhat. They are reflected in the set of indicators that can be measured at provincial and district level in a given context. This directly affects measurement of the index.</i>	<i>“Health service indicator data may be missing due to lack of services and systems for data collection and reporting”” We limited imputation only to adjacent values, and discussed the impact of the remaining data gaps on the index findings”</i>
<i>Composite indexing and methodological alternatives</i>	<i>The scaling, weighting, aggregation of indicators on the index can all be done with methods other than those chosen in the study. The study demonstrates the effect of some of the alternatives on measurement of the index. In addition the set of indicators should continuously be evaluated to remain valid, and new data sources sought.</i>	<i>Prominent. The exploration of alternatives is important to test the robustness of the index. Areas for future research are also described.</i>	<i>“For normalization, we tested z-score standardization of indicators to observe any changes in district ranks (28). We also experimented with the removal of indicators that were outliers, with unavailable data or could be represented by one proxy (e.g. syphilis treatment). We assessed the median (inter-quartile range) absolute change in district ranks using these alternative approaches(40)”</i>
<i>Describe performance</i>	<i>Use the indicators, sub-indexes and index to describe performance on the continuum of care within a given time period and geographical area</i>	<i>Prominent. The purpose of the index is to summarize performance, and analysis of sub-components enables insight into areas of improvement.</i>	<i>“The provincial score for the index increased from 62.3 in 2013 to 74 in 2017... improvements were influenced by i) increased access to services, such as cervical cancer screening, timely</i>

Key Theme	Meaning	Prominence	Example
			<i>antenatal care and ART provision, and ii) improved reporting of quality of care and linkages data over the study period. “</i>
Qualitative validation			
<i>Describe main role of framework/indicators</i>	<i>Summarizes the recurring theme around the perceived role of the overall framework of continuum of care and the associated indicator set in current public health practice.</i>	<i>Prominent. Part of the discussion of validity of indicators reflects respondents' views of the overall role of the framework and indicators. These are important findings for interpretation of the framework and indicators.</i>	<i>“In summary, the participants felt that the framework and its indicators were valid in terms of providing a broad multisectoral perspective of maternal health intervention necessary to achieve and attribute outcomes.”</i>
<i>Describe what influences validity</i>	<i>Main themes emerging from reflections of indicator validity. Two main themes around the use of proxy indicators and equity analysis. It guided general considerations for future improvement of validity of the current framework and indicators.</i>	<i>Prominent. This was one of three main areas of findings.</i>	<i>“Validity could be improved by disaggregation of indicators to reflect maternal health subgroups for equity analysis, and collection of more direct data. However, the collection of more data should be an exercise in balancing indicator utility and their precision”</i>
<i>Describe what influence feasibility</i>	<i>Reflections on feasibility of applying indicators beyond their current use, with discussion on intersectorality and harmonization of indicators emerging.</i>	<i>Prominent. This was one of three main areas of findings.</i>	<i>“Participants reflected on whether the indicators adequately captured the interface between health and other sectors in multisectoral collaboration to improve maternal health outcomes. At the interface of the health system and other sectors, participants state that the continuum of care framework should include indicators that measure intersectoral action.”</i>
<i>Describe what influence relevance</i>	<i>Reflections on the relevance of indicators and framework to current challenges in public health practice-</i>	<i>Prominent. This was one of three main areas of findings.</i>	<i>“According to participants, the relevance of the indicators can be enhanced by their alignment with current priorities for maternal health in the country. These priorities reflect subnational action and targets in maternal health services as well as the prevailing social determinants of health. In terms of services, participants noted gaps in</i>

Key Theme	Meaning	Prominence	Example
			<i>measurement of maternal nutrition and mental health interventions at the health facility level."</i>



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II. Ethical clearance and permission letters



POLICY, PLANNING, RESEARCH, MONITORING AND EVALUATION

Name of researcher : Ms. M.C. Mothupi
University of the Western Cape

Physical Address : School of Public Health
(Work/ Institution) Robert Sobukwe Road
Bellville, Cape Town

Subject : Research Approval Letter- Measurement and assessment of
continuum of care in the South African Health system, and
relationship with maternal health trajectories.

This letter serves to inform the Researcher that permission to undertake the above mentioned study has been granted by the North West Department of Health. The Researcher is expected to arrange in advance with the chosen facilities, and issue this letter as proof that permission has been granted by the Provincial office.

This letter of permission should be signed and a copy returned to the department. By signing, the Researcher agrees, binds him/herself and undertakes to furnish the Department with an electronic copy of the final research report. Alternatively, the Researcher can also provide the Department with electronic summary highlighting recommendations that will assist the department in its planning to improve some of its services where possible. Through this the Researcher will not only contribute to the academic body of knowledge but also contributes towards the bettering of health care services and thus the overall health of citizens in the North West Province.

Kindest regards


Dr. F.R.M. Reichel
Director: PPRM&E


Researcher



10/09/2018
Date

11/09/2018
Date



Healthy Living for All

1



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23 July 2018

Ms MC Mothupi
School of Public Health
Faculty of Community and Health Sciences

Ethics Reference Number: BM16/5/23

Project Title: Measurement and assessment of continuum of care in the South African Health system, and relationship with maternal health trajectories.

Approval Period: 23 February 2018 – 23 February 2019

I hereby certify that the Biomedical Science Research Ethics Committee of the University of the Western Cape approved the scientific methodology and ethics of the above mentioned research project.

Any amendments, extension or other modifications to the protocol must be submitted to the Ethics Committee for approval.

Please remember to submit a progress report in good time for annual renewal.

The Committee must be informed of any serious adverse event and/or termination of the study.

*Ms Patricia Josias
Research Ethics Committee Officer
University of the Western Cape*

PROVISIONAL REC NUMBER -130416-050



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06 December 2016

Ms MC Mothupi
School of Public Health
Faculty of Community and Health Sciences

Ethics Reference Number: BM/16/5/23

Project Title: Measurement and assessment of continuum of care in the South African health system, and relationship with maternal health trajectories.

Approval Period: 24 November 2016 – 24 November 2017

I hereby certify that the Biomedical Science Research Ethics Committee of the University of the Western Cape approved the scientific methodology and ethics of the above mentioned research project.

Any amendments, extension or other modifications to the protocol must be submitted to the Ethics Committee for approval. Please remember to submit a progress report in good time for annual renewal.

The Committee must be informed of any serious adverse event and/or termination of the study.

A handwritten signature in black ink, appearing to read 'Josias'.

*Ms Patricia Josias
Research Ethics Committee Officer
University of the Western Cape*

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III. Published Papers and Conference Presentations

Published Papers

1. **Mothupi, M. C., Knight, L., & Tabana, H. (2020a).** Review of health and non-health sector indicators for monitoring service provision along the continuum of care for maternal health. *BMC Research Notes*, 13(151). <https://dx.doi.org/10.21203/rs.2.22005/v3>
2. **Mothupi, M. C., Knight, L., & Tabana, H. (2020b).** Improving the validity, relevance and feasibility of the continuum of care framework for maternal health in South Africa: a thematic analysis of experts' perspectives. *Health Research Policy and Systems*, 18(1), 28. <https://doi.org/10.1186/s12961-020-0537-8>
3. **Mothupi, M., Knight, L., & Tabana, H. (2018).** Measurement approaches in continuum of care for maternal health: a critical interpretive synthesis of evidence from LMICs and its implications for the South African context. *BMC Health Services Research*, 18(539), 1–9. <https://doi.org/https://doi.org/10.1186/s12913-018-3278-4>

Conference Presentations

4. M Mothupi. **Evidence and Implementation Summit (03/2021).** *Accepted as Oral Presentation: Critical realism and what it can tell us about context and evidence transportability.* Sydney, Australia
5. M Mothupi. **Evidence and Implementation Summit (03/2021).** *Accepted as Oral Presentation: Analytical framework development using triangulation protocol for mixed methods findings: maternal health case study.* Sydney, Australia
6. M Mothupi. **Sixth Global Symposium on Health Systems Research (11/2020)** *Poster: Expanding the scope for assessment of the continuum of care for maternal health: integrative analysis of mixed method findings.* Dubai/Virtual Conference
7. M Mothupi. **Fifth Global Symposium on Health Systems Research (10/2018)** *Oral presentation: Development of a framework for monitoring intervention coverage and social determinants of health along the maternal continuum of care using sub-country data* Liverpool, United Kingdom
8. M Mothupi. **Public Health Association of South Africa (PHASA) Annual Conference (09/2018)** *Poster: "Using household surveys to measure inter-sectoral factors on the continuum of care for maternal health"* Parys, South Africa