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Development of indicators for integrated antenatal care service provision: a feasibility study in Burkina Faso, Kenya, Malawi, Senegal and Sierra Leone

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ABSTRACT

Objectives While service integration has gained prominence as an objective of many global initiatives, there is no widely recognised single definition of integration nor a clear understanding of how programmes are integrated into health systems to achieve improved health outcomes. This study aims to review measurement approaches for integrated antenatal care (ANC) services, propose and operationalise indicators for measuring ANC service integration and inform an integrated ANC indicator recommendation for use in low-income and middle-income countries (LMICs).

Design Feasibility study.

Setting Burkina Faso, Kenya, Malawi, Senegal and Sierra Leone.

Methods Our six-step approach included: (1) conceptualise ANC service integration models; (2) conduct a targeted literature review on measurement of ANC service integration; (3) develop criteria for ANC service integration indicators; (4) propose indicators for ANC service integration; (5) use extant data to operationalise the indicators; and (6) synthesise information to make an integrated ANC indicator recommendation for use in LMICs.

Results Given the multidimensionality of integration, we outlined three models for conceptualising ANC service integration: integrated health systems, continuity of care and coordinated care. Looking across ANC service integration estimates, there were large differences between estimates for ANC service integration depending on the model used, and in some countries, the ANC integration indicator definition within a model. No one integrated ANC indicator was consistently the highest estimate for ANC service integration. However, continuity of care was consistently the lowest estimate for ANC service integration.

Conclusions Integrated ANC services are foundational to ensuring universal health coverage. However, our findings demonstrate the complexities in monitoring indicators of ANC service quality using extant data in LMICs. Given the challenges, it is recommended that countries focus on monitoring measures of service quality. In addition, efforts should be made to improve data collection tools and routine health information systems to better capture measures of service integration.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ To our knowledge, this is the first study that uses a rigorous multistep process to propose antenatal care (ANC) service integration models (integrated health systems, continuity of care and coordinated care), develop ANC service integration indicators and operationalise the ANC service integration indicators using extant data.

⇒ The analysis was conducted using data from multiple countries, which strengthens our ability to generalise the findings to other similar contexts.

⇒ Our process for developing client-focused, coordinated care ANC service integration measures identified several challenges including overlap with quality of care measurement and substantial gaps in data availability.

⇒ No data was available to operationalise an indicator of integrated health systems as data available on the six key health system functions did not focus on the extent of integration of systems and services.

INTRODUCTION

Integrated care and service delivery has been a central theme of global health for many years, with broad support from diverse stakeholders focused on the potential benefits of coordinated mechanisms to improve health. Early recognition of the importance of comprehensive primary healthcare, as highlighted in the Alma Ata Declaration in 1978, inspired promotion of the concept of integration.[1] Over time, this inspiration has spurred action as evidenced by the emergence of a shift away from solely disease-specific vertical programming towards more horizontal, health systems-based approaches to primary healthcare service delivery.[2 3] The emphasis on integration has remained at the forefront of the global health agenda over time and has continued to be highlighted in global conferences, strategies and declarations such as

the International Conference on Population and Development in 1994, the Framework on Integrated People-Centred Health Services (IPCHS) adopted in 2016 and the Alma Ata renewal in Astana in 2018.[4–6] Most recently, the World Health Organization (WHO) General Assembly adopted a resolution to adopt the political declaration approved by the high-level meeting on universal health coverage (UHC) in 2019 which specifically highlights the importance of expanding disease programme efforts towards comprehensive and integrated service delivery approaches and the WHO's 13th General Programme of Work (2018–2023) acknowledges the importance of providing people-centred integrated services across the life course.[7 8]

While service integration has gained prominence as an objective of many global initiatives, to date there is no widely recognised single definition of integration nor a clear understanding of the ways in which programmes are integrated into health systems to achieve improved health outcomes. A literature review conducted by Armitage *et al* found 175 overlapping definitions and concepts of integrated care, indicating the absence of consensus in its definition.[9] Despite a lack of consensus on how integration is defined, some common themes about the purpose of integration have been noted, including that integration is a response to fragmentation and has the potential to strengthen linkages between services, reduce duplication, enhance patient outcomes, lead to greater client satisfaction and improve health systems performance.[10 11] Integration is a process, not an outcome. The outcomes of successful service integration are intended to be improvements in service quality, effectiveness, efficiency, comprehensiveness and ultimately should result in delivery of high-quality, person-centred care across the continuum of care.[12–14]

Antenatal care (ANC) is an ideal entry point for integrated services and a platform on which to promote healthcare that goes beyond the pregnancy period. It is during this period in a woman's life when contact (often the first) with the formal health system leads to opportunities to access and use evidence-based interventions which promote maternal and neonatal health and survival.[15] In 2016, WHO released new guidelines on ANC for a positive pregnancy experience. While the guidelines include recommendations aimed to ensure a healthy pregnancy, they also move beyond an emphasis on reducing the risk of stillbirths and pregnancy complications by also prioritising person-centred health and well-being.[16 17] A key focus of the new ANC model is quality of care, which includes both clinical provision of care and a woman's experience of care. A recent scoping review assessed measurement feasibility for the WHO recommendations for routine ANC and found that existing measures align with less than half of the recommendations for a positive pregnancy experience.[18] In addition, while the new ANC model emphasises integrated service delivery, measurement of the quality of ANC lacks a focus on the integrated nature of the ANC platform.

Based on these recent developments and recommendations for a positive pregnancy experience, it is critical to strengthen ANC service delivery through integration and to document effective approaches to doing so, especially in low-income and middle-income countries (LMICs). Monitoring ANC service integration requires the collection of data to measure and inform programme implementation and assess the impact of integrated ANC services on the population and health systems. However, there are currently no standard indicators for measuring ANC service integration. The objective of this study is to review measurement approaches for integrated services, propose indicators for measuring ANC service integration, operationalise the indicators to understand the opportunities and challenges for measuring ANC service integration using extant data from LMICs and inform an integrated ANC indicator recommendation for use in LMICs.

METHODS
Process for developing measures of ANC service integration
Our approach to developing measures of ANC service integration followed a six-step process: (1) conceptualise ANC service integration models (integrated health systems, continuity of care, coordinated care as detailed further in the results section); (2) conduct a targeted review of literature on measurement of ANC service integration; (3) develop criteria for ANC service integration indicator(s); (4) propose indicators for ANC service integration; (5) use extant data from five LMICs to operationalise the ANC service integration indicators; and (6) synthesise information to make an integrated ANC indicator recommendation for use in LMICs. Here we provide a more detailed explanation of each of the steps in the process for developing measures of ANC service integration.

1. We reviewed relevant conceptual frameworks, definitions and literature on service delivery integration to understand the distinction between service integration, continuity and quality as well as the relationship between service integration and referrals and used these findings to conceptualise ANC service integration models.
2. We conducted a targeted literature review (key search terms included ANC, integration, integrated care, coordinated care, integrated delivery networks and integrated health services.) to better understand existing ANC service integration measures, with a focus on those that have been used in LMICs.
3. We developed criteria that would be indicative of a 'good' ANC service integration indicator based on the review of the literature and supplemented with criteria to ensure feasibility for country implementation.
4. We proposed indicators for ANC service integration for each of the three ANC service integration models using the criteria of being a 'good' indicator as guiding

principles along with the review of the literature on existing ANC service integration measures.

5. In order to more fully understand the opportunities and challenges for operationalisation of the ANC service integration indicators, we used existing data from five LMICs in Africa to generate estimates of ANC service integration.

6. We synthesised the information across all phases of the measurement development process to make recommendations on measurement of integrated ANC in LMICs.

Data sources

We used existing data from Burkina Faso, Kenya, Malawi, Senegal and Sierra Leone. We selected these countries based on data availability, representation of Francophone and Anglophone Africa and status as The Global Fund to Fight AIDS, Tuberculosis and Malaria priority countries.[19 20] The analysis included data from household surveys and health facility assessments. In selecting data sources, we aligned the time period of data sources to enable comparison of measurement across data sources where possible. For the household surveys and health facility assessments, the ideal alignment was for the health facility assessment to occur two years prior to the household survey as the household survey asks women about pregnancy in the last two years.

Household survey

Data on ANC care-seeking and services received by women with recent births was obtained from the Demographic and Health Survey (DHS) programme. DHS surveys are nationally representative household surveys with a large sample size that collect data on a wide range of population, health and nutrition indicators. Each DHS final country report contains comprehensive information on the survey methodology and the questionnaires, and the data is publicly accessible through the DHS website.[21] Information on each household survey selected for this analysis can be found in table 1.

Health facility assessment

Data on health facilities and services was obtained from Service Provision Assessment (SPA) and Service Availability and Readiness Assessment (SARA) surveys which are both health facility assessments that have many similarities and a few key differences.[22] SPA and SARA surveys can both employ either a census or sample survey approach. For sample surveys, health facility samples are drawn using stratified equal probability systematic sampling from a master facility list of all formal sector facilities in the country. Both SPA and SARA collect data on facility readiness through an inventory questionnaire and service readiness indicators have been harmonised between tools. Each SPA or SARA final country report

Country	HH or HFA	Survey type and year	Study design	Sample size
Burkina Faso	HH	DHS 2010	Sample representative nationally as well as of urban and rural areas and region	6120 women
	HFA	SARA 2012	Sample of health facilities representative nationally as well as by facility type and managing authority	609 facilities offering ANC
Kenya	HH	DHS 2014	Sample representative nationally as well as of urban and rural areas, region and selected indicators at the county level	8191 women
	HFA	SPA 2010	Sample of health facilities, providers and clients representative nationally as well as by facility type, managing authority and province	561 facilities offering ANC
Malawi	HH	DHS 2015–2016	Sample representative nationally as well as of urban and rural areas, region and district	6814 women
	HFA	SPA 2013–2014	Census of all health facilities (public and private) with a sample of providers and clients at facilities	643 facilities offering ANC
Senegal	HH	DHS 2018	Sample representative nationally as well as of urban and rural areas and region	2738 women
	HFA	SPA 2016	Sample of health facilities, providers and clients representative nationally as well as by facility type	353 facilities offering ANC
Sierra Leone	HH	DHS 2013	Sample representative nationally as well as of urban and rural areas, region and district	4851 women
	HFA	SARA 2011	Sample of health facilities representative nationally as well as by facility type and region	186 facilities offering ANC

Table 1 Survey data sources

ANC, antenatal care ; DHS, Demographic and Health Survey; HFA, health facility assessment; HH, household survey; SARA, Service Availability and Readiness Assessment; SPA, Service Provision Assessment.

contains comprehensive information on the survey methodology and the questionnaires. SPA data is publicly accessible through the DHS website while SARA data was obtained by request from the WHO.[21 23] Information on each health facility assessment selected for this analysis can be found in table 1.

Defining ANC service integration
Continuity of care model
Using DHS data, we defined ANC integration for the continuity of care model as the proportion of women with a pregnancy in the last two years who received at least one ANC visit from a skilled provider (ANC1), four or more ANC visits from any provider (ANC4), skilled attendant at birth (SBA) and postnatal care (PNC) for women. The new 2016 WHO ANC model recommends a minimum of eight ANC contacts (ANC8) as opposed to the earlier four recommended visits. As several of the household surveys used in this study were conducted pre-2016 (ie, prior to the release of the new ANC8 guidelines), and countries have been implementing ANC8 recommendations at varying timelines, we selected ANC4 as our measure of ANC coverage in this context and to best capture ANC across settings. To create the ANC integration composite indicator, we first calculated coverage of the four individual interventions across the continuum of care for women—ANC1, ANC4, SBA and PNC. All indicators were calculated among women aged 15–49 years with a live birth in the two years prior to the survey. Skilled health personnel for both ANC and SBA were defined per country policy and aligned with the DHS report per indicator and country. See online supplemental table 1 for additional details on continuity of care indicator definitions and online supplemental table 2 for additional details on country specific adaptations to coverage indicators. In addition, we created composite indicators for each possible combination of interventions to further explore which elements of the continuum of care are closely aligned and can help to understand where dropout is occurring.

Coordinated care model
Using the SPA and SARA data, we defined ANC integration for the coordinated care model at the client level and at the facility level. For this specific analysis example, we defined ANC integration for the coordinated care model at the client level as the proportion of women who received a first ANC visit at less than 12 weeks of gestation where the provider took a blood pressure measurement, prescribed or gave iron and/or iron and folic acid (IFA) tablets, provided counselling on birth preparedness and performed or referred for an HIV test during that visit. To create this composite indicator, we first created a binary indicator for each provision of care item. The composite indicator was calculated as an unweighted average of the provision of care items and proportion of women receiving all items. All indicators were calculated among

women attending ANC for a first consultation with gestational age less than 12 weeks.

We defined ANC integration for the coordinated care model at the facility level as the proportion of facilities that offer ANC and malaria services at the same facility (co-location of services) and have the required trained staff and guidelines, equipment, diagnostics and medicines to deliver the services (co-location and service readiness) on the day of the assessment. See online supplemental table 3 for additional details on each of the items included in the co-location of services and service readiness indicator. To create this composite indicator, we first created a binary indicator for each service availability and readiness item. The composite indicator was calculated as an unweighted average of the service availability and readiness items and proportion of facilities with all items. All indicators were calculated among facilities offering ANC.

Statistical analysis
Continuity of care model
We analysed the continuity of care integrated ANC indicator descriptively in three ways. First, we described the level of coverage for individual points of contact in the care continuum using proportions for each country. Second, we displayed the different combinations of maternal health services within the continuum of care that women received. Finally, we presented the cascade of services within the continuum of care to indicate the proportion of women who moved from one service to the next.

Coordinated care model
We analysed the coordinated care integrated ANC indicators descriptively. At the client level, we analysed the integrated ANC indicator by provision of care component and overall using proportions for each country. At the facility level, we analysed the integrated ANC indicator by service availability and readiness item, domain and overall using proportions for each country.

All analyses for all models were adjusted for the survey design (clustering, stratification and survey weights). Data analysis was conducted in Stata V.16.[24]

Patient and public involvement
Patients and the general public were not involved in the design and conduct of this research. However, the preliminary findings from this research were presented to Mother and Newborn Information for Tracking Outcomes and Results (MoNITOR), a technical advisory group that aims to facilitate measurement, align initiatives and provide technical guidance to the WHO. Feedback from MoNITOR was incorporated into the study.

RESULTS
Conceptualisation of ANC service integration models
Our conceptualisation of ANC service integration models started with a literature review on service delivery

integration to identify key conceptual frameworks for defining and measuring integrated care. Integrated care was often described as a multidimensional concept. However, the number of dimensions varied across frameworks and there were inconsistencies in the number, naming and content of dimensions. Several dimensions were captured across all frameworks including type, breadth and degree of integration.[9 25–33] Additional dimensions incorporated in some frameworks included process,[27] level,[25 28] time span, mechanism and real/virtual.[28] While often formulated in different ways, the commonality among the dimensions of level of integration was a distinction between micro and meso/macro levels of integration where the micro level focused on a seamless care experience for the individual through improved continuity, coherence and cooperation in the delivery of care to individuals while the meso/macro level focused on system level improvements such as organisational and professional integration and mainstreaming of financing and regulation of the healthcare system.[9 30 33] Common to all frameworks was a foundational belief in people-centred health services and a desire for integrated care to achieve improved health outcomes through improved coordination of care and continuity of care for individuals.

To further our thinking about what integrated care means for ANC in LMICs, we reviewed the myriad of definitions of integrated care and chose the definition of integrated health services based on the WHO Framework on IPCHS for the basis of conceptualisation of ANC service integration models as it is closely aligned with the goals of the ANC model for a positive pregnancy experience. The IPCHS defines integrated health services as 'health services that are managed and delivered in a way that ensures people receive a continuum of health promotion, disease prevention, diagnosis, treatment, disease management, rehabilitation and palliative care services, at the different levels and sites of care within the health system, and according to their needs, throughout their whole life'.[5]

Our ANC service integration model ideally would capture multiple dimensions including the most common dimensions of integration (type, breadth and degree of integration), cover both the micro and meso/macro levels and include a patient-perspective of integrated care. Given the multidimensionality of integration, it would be difficult to capture all these attributes in a single model. Therefore, we outlined the following three models for conceptualising ANC service integration:

1. **Integrated health systems**—Integration of programmes within the health system; ANC integration within the broader health system including governance, financing, service delivery, information systems.
2. **Continuity of care**—Continuum of care across the life course; ANC integration across the pregnancy, birth and postpartum life course. This would assess if pregnant women receive interventions across the continuum of antenatal, intrapartum and postpartum care

(eg, attended ANC, delivered in a facility with a skilled provider and received appropriate postpartum care).
3. **Coordinated care**—Coordination of care at a single visit; integration of disease-specific services such as HIV, tuberculosis (TB), malaria, sexually transmitted infection and/or immunisation into routine ANC services as defined by the minimum package based on the new WHO ANC guidelines. This would assess if a woman attending ANC receives the services bundled as needed based on her pregnancy and any other possible conditions (eg, syphilis testing, HIV testing, intermittent preventive treatment of malaria in pregnancy (IPTp), TB testing/treatment and/or immunisations).

Literature review on measurement of ANC service integration

A literature review on measurement of ANC service integration in LMICs identified indicators to measure ANC service integration using a variety of data sources including household surveys, health facility assessments and routine data (see online supplemental table 4). Notably, we found that most ANC integration measures conceptualised ANC service integration as coordinated patient care while a few studies conceptualised ANC service integration as integration of services across the continuum of care. We did not find any examples of measures of ANC service integration with the general health system; however, we did find several examples of disease specific service integration with the general health system which we reviewed to gain an understanding of health system measures.

Coordinated patient care was measured through the integration of ANC with one or more additional service areas. ANC services were most commonly integrated with infectious disease services (HIV, TB and malaria),[34–36] however a recent initiative has also explored integration of ANC with family planning counselling, maternal nutrition, prevention of mother-to-child transmission of HIV and post-abortion care and family planning services.[37] Various measures of integrated ANC were presented within each study with similar types of measures across studies at both the facility level and individual ANC client level. The most common types of facility-level ANC integration measures were co-location of services (availability of both ANC and an additional service at the same facility but not necessarily by the same provider), cross-training of staff (staff provides ANC and has been recently trained in the additional service area) and readiness to deliver services (availability of equipment, medicines and/or diagnostics required for the services being integrated into ANC). In addition, a composite indicator combining co-location of services, cross-training of staff and readiness to deliver services was developed as an overall measure of ANC integration capacity. At the individual-level, the most common ANC integration measure was receipt of integrated ANC as evidenced by provision of one or more specific interventions to a pregnant woman during an ANC visit (eg, receipt of insecticide treated nets (ITNs) or counselling on sleeping under an ITN, observation of consumption of antimalarial (IPTp-sulfadoxine-pyrimethamine

(SP)) after 16 weeks gestation, receipt of HIV counselling and testing during first ANC visit, postpartum family planning counselling, or nutrition advice). The data used and proposed for measuring coordinated patient care includes data from health facility assessments,[34–36] routine health information systems[36 37] and household surveys.[36] Studying ANC integration through the lens of integrating vertical disease specific programmes into broader primary healthcare platforms was the primary rationale for developing these ANC service integration measures.[34–36] However, achieving UHC through people-centred, integrated primary healthcare was a motivating force for developing one set of ANC integration measures. Notably, this set of measures focused not only on integration of services during ANC but also at other service delivery entry points including delivery, PNC, infant care and community-based services.[37]

Continuity of care was measured through the integration of services across the continuum of care for maternal health with a focus on receipt of services from ANC to delivery care to PNC. The main measure assessed dropout along the cascade of services across the continuum of care to understand where women may be missing continuity of care. In addition, an analysis of the combination of maternal health services within the continuum of care that women are receiving was conducted to further understand places in the continuum where dropout occurs. A total of five services were assessed in the continuum—at least one ANC visit, four or more ANC visits, delivery with a skilled birth attendant, postnatal check within 24 hours for the woman and family planning counselling within one year of birth. Household survey data was the primary data source used for measuring continuity of care.[38–43] Studying the continuum of care pathway was the main rationale for developing these measures. While these measures were not explicitly presented as measures of integration, a key goal of the continuum of care is to provide women with a unified, integrated approach to care across the life course and this analysis aligns with our conceptualisation of integrated care across the continuum of care for maternal health.

Health systems integration was measured in a series of country case studies that aimed to explore the scope and extent of integration of HIV/AIDS and TB interventions into the wider health system.[44–48] These case studies used a methodology that built on the work of the Atun *et al* health systems framework which was developed to define and assess the nature and extent of integration of priority health interventions in relation to critical health system functions.[31] Health systems integration was evaluated against 25 elements of integration across six functions of the health system: stewardship and governance, service delivery, demand generation, monitoring and evaluation, planning and financing (see online supplemental table 5 for a list of the elements). Each element of integration was classified as being 'fully/predominantly integrated', 'partially integrated' or 'not or predominantly not integrated'. Data was collected through a combination of document review and qualitative key informant interviews.

Criteria for ANC service integration indicators

We developed a set of criteria that would be important for a 'good' indicator of ANC service integration that was based on the review of the literature and supplemented with criteria to ensure feasibility for country implementation. The goal was to develop a set of comprehensive criteria that would serve as guiding principles for developing the ANC service integration indicators while acknowledging that it may be difficult to incorporate all criteria into any single measure of ANC service integration. The criteria include the following:

► An indicator of ANC integration should incorporate current guidelines and recommendations for best practices for the content of care throughout the pregnancy and the multiple contacts with the health system.

   i. The WHO guidelines on ANC for a positive pregnancy experience and WHO framework for the quality of ANC along with country specific guidelines can serve as a reference for the content of care (Provision of care should include maternal and fetal assessment and management, provision of nutritional interventions, infectious disease testing and management and counselling and information sharing. Experience of care should include physiological symptoms assessment and management. Provision and experience of care are reliant on availability of physical and human resources. ANC services are delivered through the larger health system; the structures and functions of the larger health system directly impact the care delivered to pregnant women.).[16 18]

► An indicator of ANC integration should expand beyond the ANC service package and incorporate additional disease-specific services that pregnant women may need to access in addition to the ANC intervention package.

► An indicator of ANC integration should be measurable with extant data in LMICs. This data can come from household surveys, health facility assessments and/or routine health information systems. There is a preference for at least one integrated ANC indicator that can be measured on a routine basis so that countries can assess performance at more regular intervals.

► An indicator of ANC integration should account for differences in health system contexts within and between countries.

   i. Within countries, different levels of health facilities (ie, primary vs secondary/tertiary health facilities) are expected to have the capacity to deliver different packages of health services.

   ii. Across countries, there are differing disease burdens and differing service packages offered through health facilities (ie, not all countries are

malaria endemic or have a high prevalence of certain communicable diseases such as HIV or TB). A measure of ANC service integration should account for the disease burden and services offered and required in a country.

iii. The extent to which services can be integrated may be dependent on health system specific characteristics including, but not limited to:
- The ability and willingness of healthcare workers to provide integrated services; integration may be dependent on the skills/training of health workers.
- Service specific user fees, for example, ANC services may be free, but TB services may not be.

Proposed indicators for measuring ANC service integration

We then proposed indicators for measuring ANC service integration for each of the three ANC service integration models using the criteria of being a 'good' indicator as guiding principles along with the review of the literature on existing ANC service integration measures. Several criteria were prioritised during the indicator development process namely, that the indicator incorporate current guidelines and recommendations for best practices for the content of care and be measurable with extant data in LMICs. Indicators for which these two criteria could not be met were excluded from further consideration. A number of different data sources can potentially be used to measure ANC service integration in LMICs including household survey data, health facility assessment data and routine health information system (RHIS) data. Each of these data sources are unique in the way in which data is collected and all have potential limitations as to how useful they may be in measuring ANC service integration. We reviewed common tools for each data source and assessed the feasibility of using each data source to measure ANC service integration in LMICs. We used both household survey data (DHS) and health facility assessment data (SPA and SARA) for this analysis as both of these data sources were accessible for a multitude of LMICs.[49–51] While RHIS data is readily available for country use, it can be difficult to access more broadly and was not available at the time of this study to our research team. As such, for the purposes of this analysis, we have excluded its use.

Integrated health systems

While household surveys such as the DHS do not collect data relevant to measuring health systems, health facility assessments such as SPA and SARA do collect health systems data. A review of the elements of integration across the six key health system functions of stewardship and governance, service delivery, demand generation, monitoring and evaluation, planning and financing showed that health facility assessment data can largely be used to report on availability of service delivery infrastructure and human resources as well as on some aspects of monitoring and evaluation and financing. RHISs also

have the potential to provide some data across the same domains. However, the focus of these data are not on the extent of integration of systems and services and instead focus more generally on service availability, service readiness and quality of care for individual health services or the facility overall. Therefore, the data are not best suited to develop a comprehensive quantitative measure of integrated health systems for ANC. As such, no integrated health systems indicators were proposed that can be measured with extant data in LMICs.

Continuity of care

Health facility assessments collect information at a single point in time and do not collect information over the life course to enable calculation of indicators related to continuity of care. RHIS data is similarly not suitable for calculating indicators related to continuity of care. RHISs in LMICs commonly report data in an aggregate form with the facility being the lowest unit of reporting (patient level data is generally not reported). As such, analysis of RHIS data is limited to the data elements reported in the system; it is not possible to track patients over time or across services. In addition, RHIS data are generally counts of services delivered which would need to be combined with data on the estimated population in need of an intervention to create a population-based coverage estimate. Conversely, household surveys collect information from women with a recent birth and ask about care received from pregnancy to delivery and through the postpartum period. This approach to data collection allows for tracking the coverage of interventions a woman has received over the life course. As such, the proposed indicator for continuity of care draws from household survey data and is the proportion of women with a pregnancy in the last two years who received at least one ANC visit, four or more ANC visits, delivery with a SBA and PNC within 24 hours for the woman (online supplemental table 6).

Coordinated care

While household surveys collect some information related to the content of care received by pregnant women, the timing of each intervention is not collected, information on counselling has only recently started to be collected and the number of ANC intervention components asked about is limited. RHISs in LMICs collect information on service usage and in some countries contain data related to content of care. A review of the content of registers and reporting systems in LMICs found that many RHISs are able to track use of services (ie, number of ANC1 and ANC4 visits). However, information on preventative treatments in ANC such as IFA, IPTp and deworming is often collected in registers, but not always sent to higher levels to use in national and subnational analyses. In addition, screening for complications such as routine checks (ie, blood pressure measurement) is not generally captured in registers at all. Areas of strength include reporting on tetanus toxoid immunisation and syphilis testing and treatment. In addition, there are few indicators in

RHISs that incorporate multiple content of care elements and those that are present generally only measure the number of ANC consultations delivered in which one additional disease specific diagnosis, prevention and/or treatment intervention was also delivered.[52] As such, RHIS data may be a feasible source for measuring co-location of services. Health facility assessments collect information from health facilities on the availability of services, readiness to deliver care and quality of care. All health facility assessments include a health facility audit component which collects information on service availability and service readiness, which is the availability of essential inputs to deliver high-quality health services. This includes the availability of services, trained staff and guidelines, equipment, diagnostics, medicines and other critical infrastructure. However, only some health facility assessments include observations of ANC consultations to collect data on the technical content of care delivered. A direct observation of an ANC consultation collects data on a woman's gestational age and the content of care received at that particular visit including the maternal and fetal assessment and management interventions, nutrition interventions, counselling and additional disease specific interventions a woman received at the visit. However, one potential limitation of this data source is that it is not known what interventions a woman has received at previous ANC visits which is important to understand to determine the care required at any particular visit.[49 50] As such, the proposed indicators for coordinated care draw from health facility assessment data and are: provision of care—proportion of women who received an ANC consultation and received at least one assessment and management intervention, one nutrition intervention, one infectious disease specific intervention and one counselling intervention as appropriate for the gestational age of the pregnancy; co-location of services—proportion of facilities that offer ANC services plus one (or more) additional service in the same site/facility; and co-location of services and service readiness—proportion of facilities that offer ANC services plus one (or more) additional service in the same site/facility and also have the trained staff and guidelines, equipment, diagnostics, medicines and/or other critical infrastructure required to deliver ANC and the additional service in the same site/facility (online supplemental table 6).

The proposed indicators for coordinated care have been separated into two levels—client level and facility level. At the client level, coordinated care refers to provision of care or the same provider offering a range of services to a client during a single consultation. We attempted to create an indicator that incorporated aspects of both provision and experience of care, but based on the scoping review by Lattof *et al*, found that there are no existing measures that map to the WHO recommendations on ANC for a positive pregnancy related to women's experience of ANC. In addition, data on women's experience of ANC in terms of communication, support and respect are sparse and infrequently collected.[18] As such, the proposed client level coordinated care measure focuses on provision of care only. At the facility level, coordinated care refers to co-location of services or a range of services is available at the same site or within the same facility. Co-location of services can be limited to service availability or extended to include service availability and readiness to deliver the services (ie, the facility has the required trained staff and guidelines, equipment, diagnostics, medicines and/or other critical infrastructure).

As the coordinated care indicators are broader and allow for some choice and adaptation to country specific contexts, a more specific example is provided in online supplemental table 6. For the client level indicator, we have selected integration of two services (ANC and malaria) for this example, but integration of a multitude of services could have been applied here.

Operationalising the ANC service integration indicators
Continuity of care

Figure 1A and online supplemental table 7 contain information on the proportion of women receiving each of the four key interventions (ANC1, ANC4, SBA and PNC) across the continuum of care by country. For all countries, the most common service received was at least one ANC visit which was near universal and varied from 95% in Kenya and Malawi to 98% in Senegal. The proportion of women receiving four or more ANC visits varied greatly from 33% in Burkina Faso to 88% in Sierra Leone. In all countries except Sierra Leone, the proportion of women who received four or more ANC visits showed a steep decline and was nearly half the proportion for one ANC visit. The proportion of women receiving skilled birth attendance ranged from 63% in Sierra Leone to 91% in Malawi. In four out of five countries, skilled birth attendance was higher than four or more ANC visits while in three out of five countries skilled birth attendance was lower than PNC for the woman. The proportion of women who received PNC within 24 hours also varied greatly, from 28% in Kenya to 85% in Burkina Faso and Senegal. In two countries PNC was the second most commonly received intervention while in two countries it was the least commonly received intervention.

A depiction of the different combinations of maternal health services within the continuum of care that women received is presented in table 2. Very few women received no services at all (less than 4% in all countries) while the proportion of women receiving all services varied among countries from 15.9% in Kenya to 53.5% in Sierra Leone. In all five countries, receiving all four services was in the top three most common combinations (shown in green in table 2). However, the most common combination was different across countries. The most common combination of services in Senegal and Sierra Leone was all four services (46.2% and 53.5%, respectively). For Burkina Faso and Kenya, the most common combination of services was receiving three out of four services. For Burkina Faso, this included all services except four or more ANC visits (43.3%) while in Kenya this included all services except
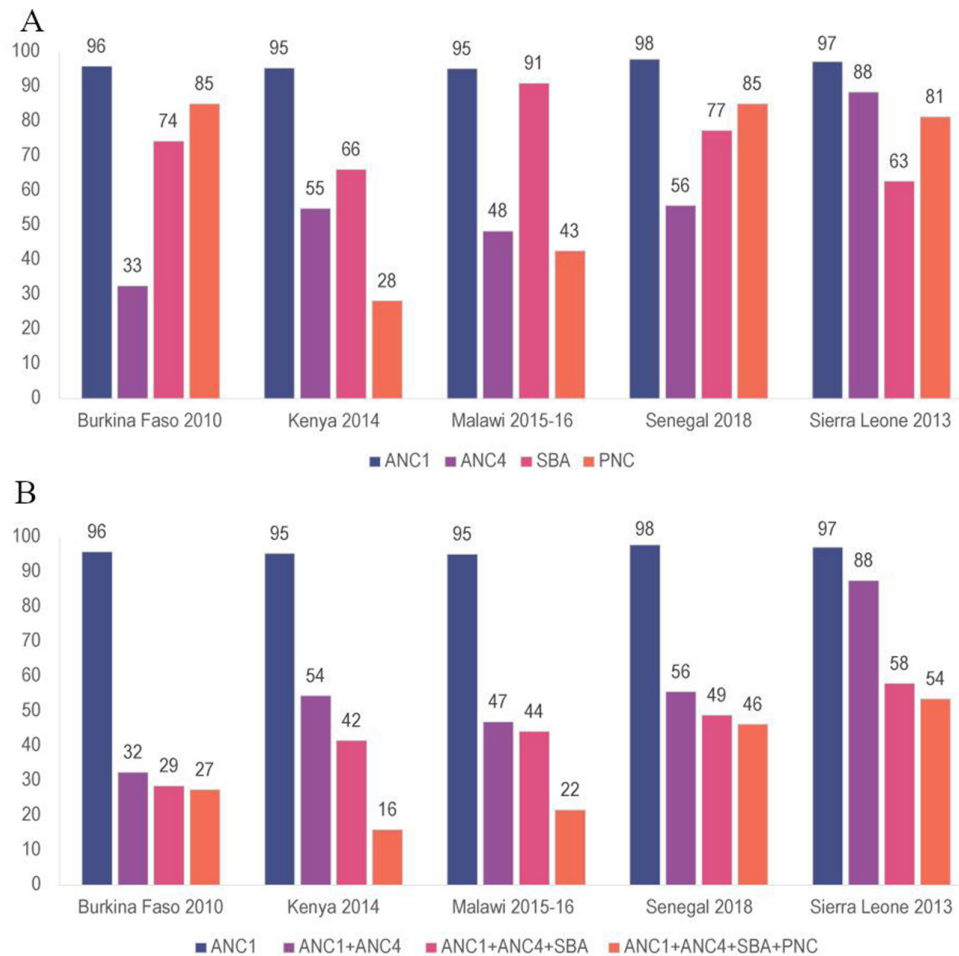
Figure 1 Continuum of care estimates, by country. ANC, antenatal care; DHS, Demographic and Health Survey; PNC, postnatal care; SBA, skilled attendant at birth.

PNC for women (25.6%). Finally, in Malawi the most common combination of services was receiving only two services, ANC and SBA (25.2%). Combinations excluding ANC1 were uncommon in all countries (less than 1%).

Figure 1B and online supplemental table 8 contain information on the proportion of women who dropped-out of the continuum of care from one service to the next from ANC1 through PNC. This provides a visual cascade of services within the continuum of care to indicate the proportions of women who moved from one service to the next and the proportion of women who dropped-out along the continuum. In four out of five countries (all but Sierra Leone) the largest dropout occurred between ANC1 and ANC4 (43%–66% decrease). In two countries (Kenya and Malawi), there was also substantial dropout in the later phase of the continuum with a more than 50% decrease from SBA to PNC. In Sierra Leone, the largest dropout occurred from ANC4 to SBA, a 34% decrease.

Coordinated care

Figure 2A and online supplemental table 9 contain information on client-level provision of coordinated care for the three countries that had direct observation data. Client-level provision of coordinated care assessed

the proportion of women who received an ANC consultation and received one assessment and management intervention, one nutrition intervention, one infectious disease specific intervention and one counselling intervention at the first ANC visit. The proportion of women receiving coordinated care ranged from 12.3% in Senegal to 33.9% in Kenya. On average, women received more than two-thirds of the required interventions (68.1% in Malawi, 69.6% in Senegal and 75.0% in Kenya). There was substantial variability in which services were most commonly delivered, with no one service being consistently delivered across countries.

Figure 2B and online supplemental table 9 contain information on facility-level co-location of services for all five countries. Facility-level co-location of services assessed the proportion of facilities that offered both ANC and malaria services. In all countries, more than 60% of the facilities had co-location of services with the proportion of facilities with co-location of services ranging from 64.0% in Malawi to 92.8% in Sierra Leone.

Figure 2C and online supplemental table 9 contain information on facility-level co-location of services and service readiness for all five countries. Facility-level

Table 2 Proportion of women who received each continuum of care outcome combination, by country

Combination of care outcomes								
ANC1	ANC4	SBA	PNC	Burkina Faso 2010	Kenya 2014	Malawi 2015–2016	Senegal 2018	Sierra Leone 2013
None				2.9	3.4	1	1.5	1.1
x				7.6	15.6	4.2	7.3	2.3
	x			0	0.1	0.1	0	0.2
		x		0.1	0.5	1.6	0	0
			x	0.8	0.2	0.1	0.3	0.6
x	x			1.6	11	2	2.1	10.3
x		x		1.8	15.6	25.2	1.5	0.4
x			x	10.6	1.7	0.9	6.8	3.2
	x	x		0	0.2	0.8	0	0
	x		x	0	0	0	0.1	0.4
		x	x	0.4	0.2	0.8	0.2	0.3
x	x	x		1.1	25.6	22.5	2.6	4.4
x	x		x	2.4	2	0.8	4.7	19.2
x		x	x	43.3	8	17.9	26.7	3.8
	x	x	x	0.1	0	0.4	0	0.1
x	x	x	x	27.4	15.9	21.6	46.2	53.5

Source: Household survey data (Demographic and Health Survey).
Top three combinations highlighted in green for each country.
ANC, antenatal care ; PNC, postnatal care ; SBA, skilled attendant at birth .

co-location of services and service readiness assessed the proportion of facilities that offered both ANC and malaria services and also had the trained staff and guidelines, equipment, diagnostics and medicines required to deliver ANC and malaria services. Almost no facilities (less than 2%) met the criteria for co-location of services and service readiness across all countries. On average facilities had 54.8% (Malawi) to 71.5% (Burkina Faso) of the items required for co-location of services and service readiness. Some patterns across domains were seen. For example, diagnostic capacity was the least available domain in all countries, ranging from 19.8% in Sierra Leone to 54.7% in Senegal. In addition, haemoglobin testing capacity was the least available item in four out of five countries. However, there was substantial variability across the remaining domains in terms of performance. For example, the availability of equipment was a strength in Burkina Faso (95.7%), but a weakness in Malawi (44.2%).

Comparison of indicators of ANC integration

A comparison of ANC integration estimates is presented in figure 3. Looking across ANC service integration estimates, there are large differences between estimates for ANC service integration depending on the model used, and in some countries, the ANC integration indicator definition within a model. No one integrated ANC indicator was consistently the highest estimate for ANC service integration. However, continuity of care was consistently the lowest estimate for ANC service integration. In some countries, coordinated care estimates were all similar (Malawi, Senegal). However, in other countries this was not the case (Burkina Faso, Sierra Leone).

DISCUSSION

Our proposed models and indicators for ANC service integration provide an approach to evaluating ANC service integration in LMICs using existing data. Through a rigorous multistep process, we have proposed three ANC service integration models (integrated health systems, continuity of care and coordinated care), developed ANC service integration indicators for two of the three models and operationalised the ANC service integration indicators using extant data from five countries (Burkina Faso, Kenya, Malawi, Senegal and Sierra Leone). Use of these ANC service integration measures can help identify weaknesses in service integration and guide strategies for improving service delivery.

Our findings demonstrate that measuring integration of ANC is complex. However, monitoring ANC service integration may be useful for countries exploring service delivery redesign. At the health systems level, service delivery redesign should focus on integration of systems rather than specific services. This may include improving coordination between sectors, prioritising primary healthcare and prioritising provider payment mechanisms that promote integrated care. At the client level, service delivery redesign should have an emphasis on, and evaluation of, quality of care including a stronger focus on clients and the client experience.[53] In addition, health

Figure 2 Coordinated care estimates, by country. ANC, antenatal care; IFA, iron and folic acid.

information systems should be redesigned to ensure they include comprehensive measures of quality of care as well as measures of service integration.

Our results from operationalising the ANC service integration indicators showed that different ANC service integration measures generate very different results on the level of integration achieved. We found large differences between estimates for ANC service integration depending on the model used, and in some countries, the ANC integration indicator definition within a model. Our findings highlight the complexities of measuring service integration and the multitudinous underlying constructs that require unpacking for assessing integrated care. While 'integration' has become an international buzzword, careful thought is required about what integration means in practice in order to appropriately measure, monitor

Source: Household survey data (DHS) and Health facility assessment data (SPA and SARA)
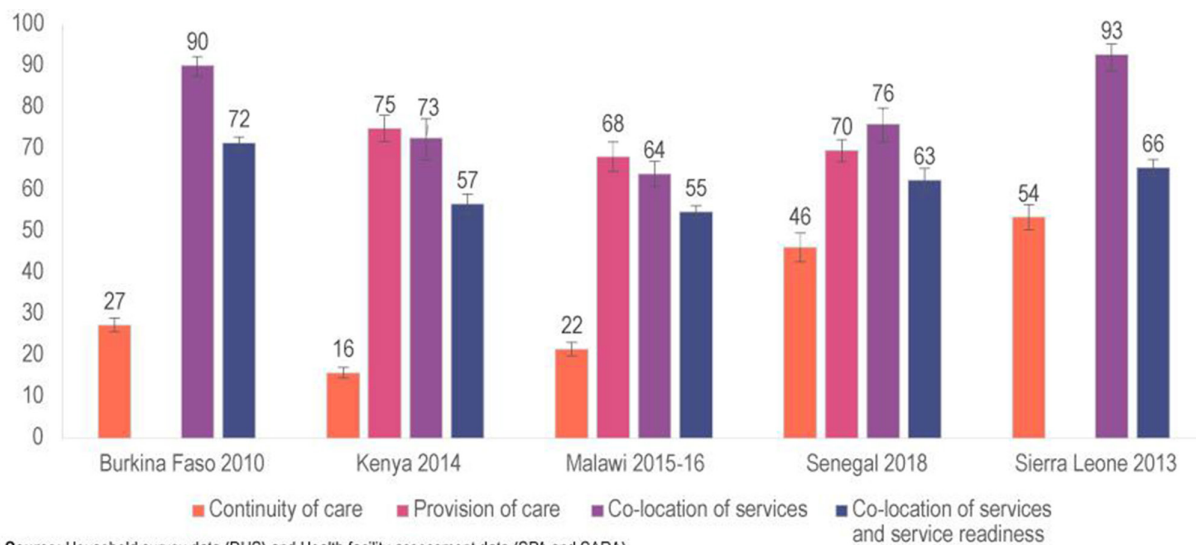
Figure 3 Comparison of ANC service integration estimates, by country. ANC, antenatal care; DHS, Demographic and Health Survey; SARA, Service Availability and Readiness Assessment; SPA, Service Provision Assessment.

and design strategies to improve it.[54 55] Measuring integration for any one service may require a diverse set of indicators to understand the underlying constructs including integrated health service delivery systems, integrated client care over time and integrated client care during a single visit. It is also important to recognise that integration of organisations and health systems may or may not result in integration of the care delivered to clients and similarly may or may not promote care that is focused on client needs.[56] It is thus important to measure multiple integration constructs to understand what is happening at the system level and at the client care level.

Our process for developing client-focused, coordinated care ANC service integration measures identified several challenges including overlap with quality of care measurement and substantial gaps in data availability. Delivering high-quality health services is essential to achieving UHC and Sustainable Development Goal (SDG) three and requires care that is safe, effective, people-centred, timely, efficient, equitable and integrated.[4 5 7 8 57] Standard measures for ANC service quality have been developed and there is notable overlap between measures of a high-quality ANC service and the client-level measures of ANC service integration we explored.[18 58 59] However, ANC service quality indicators may be more comprehensive, encompassing all aspects of a high-quality ANC service instead of a set of tracer items as proposed with the client-level ANC service integration indicators. It is also important to recognise that data are lacking to incorporate experience of care into both ANC service quality measures and ANC service integration measures.[59–61] The data sources available in LMICs do not adequately capture if care was delivered with respect for patient's values, preferences and expressed needs and with a focus on effective communication, respect and preservation of dignity and emotional support.[58 62 63] Experience of care is important to the provision of a high-quality, integrated health service as patients who have a positive care experience are more likely

to receive accurate diagnoses and treatment, increase their adherence to provider recommendations and treatment and continue to use health services.[64 65]

Each ANC service integration measure we explored demonstrated both advantages and disadvantages. Measuring ANC service integration through the lens of an integrated health system is useful for examining the overall degree of system integration including key aspects of ANC integration such as service delivery models, health workforce organisation, community engagement and referral systems and linkages between facilities. However, extant data does not capture these data and no integrated health systems indicators were proposed for this analysis. Measuring the continuity of care provides information on which interventions a woman received over the life course, but current data sources do not include information on where the services were delivered and how referral systems may have assisted in ensuring continuity of care. Coordinated care measures are adaptable to each country context, which is important for ANC as the package of services delivered is country specific. However, it may be difficult to monitor changes over time and across contexts if the same items have not been included in coordinated care indicators. In addition, there is substantial overlap between coordinated care and quality of care measures. Finally, all ANC service integration indicators cannot be currently measured using RHIS data which is important for regular monitoring. Improvements in the RHIS to include patient-level data and more specific facility-level integration indicators are needed to adequately capture ANC service integration measures. Given the lessons learnt exploring ANC service integration measures, we recommend that countries use quality of care measures as a proxy for ANC service integration while simultaneously strengthening individual-level routine data so ANC service integration measures can be captured.

CONCLUSION

Integrated ANC services are foundational to ensuring UHC. However, our findings demonstrate the complexities in monitoring indicators of ANC service integration using extant data in LMICs. Given the challenges, it is recommended that countries focus on monitoring measures of service quality. In addition, efforts should be made to improve data collection tools and routine health information systems to better capture measures of service integration. Our study also found that a substantial gap remains in the ability to measure ANC and health systems integration; and therefore, there is a critical need to focus future research efforts on development, feasibility and operationalisation of such indicators. We have highlighted the importance and challenges of incorporating ANC service integration measures into country monitoring and evaluation. By doing so, we have provided practical guidance to policymakers and governments in LMICs who aim to improve ANC service integration. Further research will be required at global and country level to develop meaningful, valid measures of ANC service integration that take into account the complex nature of integration and the availability of data in LMICs.

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Patient consent for publication Not applicable.

Ethics approval Not applicable.

Provenance and peer review Not commissioned; externally peer reviewed.

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