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RESEARCH ARTICLE

General Obstetrics

Where is the 'C' in antenatal care and postnatal care: A multi-country survey of availability of antenatal and postnatal care in low- and middle-income settings

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Abstract

Objective: Antenatal (ANC) and postnatal care (PNC) are logical entry points for prevention and treatment of pregnancy-related illness and to reduce perinatal mortality. We developed signal functions and assessed availability of the essential components of care.

Design: Cross-sectional survey.

Setting: Afghanistan, Chad, Ghana, Tanzania, Togo.

Sample: Three hundred and twenty-one healthcare facilities.

Methods: Fifteen essential components or signal functions of ANC and PNC were identified. Healthcare facility assessment for availability of each component, human resources, equipment, drugs and consumables required to provide each component.

Main outcome measure: Availability of ANC PNC components.

Results: Across all countries, healthcare providers are available (median number per facility: 8; interquartile range [IQR] 3–17) with a ratio of 3:1 for secondary versus primary care. Significantly more women attend for ANC than PNC (1668 versus 300 per facility/year). None of the healthcare facilities was able to provide all 15 essential components of ANC and PNC. The majority (>75%) could provide five components: diagnosis and management of syphilis, vaccination to prevent tetanus, BMI assessment, gestational diabetes screening, monitoring newborn growth. In Sub-Saharan countries, interventions for malaria and HIV (including prevention of mother to child transmission [PMTCT]) were available in 11.7–86.5% of facilities. Prevention and management of TB; assessment of pre- or post-term birth, fetal wellbeing, detection of multiple pregnancy, abnormal lie and presentation; screening and support for mental health and domestic abuse were provided in <25% of facilities.

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Conclusions: Essential components of ANC and PNC are not in place. Focused attention on content is required if perinatal mortality and maternal morbidity during and after pregnancy are to be reduced.

KEYWORDS
developing countries—obstetrics and gynaecology, health services research, maternity services

Tweetable abstract: ANC and PNC are essential care bundles. We identified 15 core components. These are not in place in the majority of LMIC settings.

1 | INTRODUCTION

The global strategy for women's, children's and adolescents' health 'Survive, Thrive, Transform' calls for concerted and continued international efforts to enable and ensure the well-being of all.[1] In line with the Sustainable Development Goals (SDGs), it goes on to emphasise the need for a re-focus on the right to the highest attainable standard of health for all (SDG3), particularly for those women who are most vulnerable.

Ending preventable maternal deaths, stillbirths and neonatal deaths crucially requires that women have access to quality care during and after pregnancy and at the time of birth. A key concept that has shaped the post MDG debate and the definition of SDGs is universal health coverage (UHC), defined as 'universal access to needed health services without suffering financial hardship while paying for them'.[2] For women and babies these essential health services consist of a series of intervention packages (or 'care bundles') known as the 'continuum of care' including antenatal care (ANC), skilled birth attendance (SBA), emergency obstetric care (EmOC), early newborn care (NC), postnatal care (PNC) and family planning (FP). These should be provided by a functioning health system (including at the community and healthcare facility levels) such that every woman and baby receive care that is effective, valued, trusted and respectful.[3]

Pregnant women represent the highest number of healthcare users globally. Over 80% of women in low- and middle-income countries (LMIC) attend a healthcare facility during pregnancy at least once for ANC and more than 55% attend four times or more. Fewer women and babies return for PNC after birth even though the majority of women give birth at a healthcare facility.[4,5]

Antenatal care should include screening for, prevention and management of infections such as malaria, HIV, tuberculosis (TB), syphilis, neonatal tetanus; complications of pregnancy such as pre-eclampsia, anaemia, gestational diabetes, preterm birth; and assessment of and care for mental and social ill-health.[3] Care in the period following birth (PNC) is similarly critical not only for survival but also for the future health and development of the mother and her baby. An important challenge relates to provision of support for family planning to address the unmet need for contraception, a need which, if addressed, could prevent millions of unintended pregnancies.[6,7]

New international recommendations for ANC and PNC advise that a woman has a minimum of eight visits or contacts during pregnancy and four after pregnancy with the aim to reduce perinatal mortality and improve women's experiences of care.[8,9] ANC and PNC are established and logical 'entry points' for the critical expansion of integrated disease prevention, screening and treatment. With a large number of women accessing care during pregnancy, the ANC platform has also been 'used' for the wider public health agenda. For example, in countries with generalised HIV epidemics (defined as a prevalence of at least 1% among pregnant women attending ANC), national estimates of the prevalence of HIV are mostly based on data from surveillance systems that use data from women who attend a selected number of sentinel ANC clinics.[10,11] Pooled blood samples from women attending ANC are thus used to assess country prevalence of HIV and syphilis and may be considered for estimation of burden of disease in the community including potentially for COVID-19. Similarly, ANC and PNC platforms are commonly used for child vaccination against TB, tetanus and possibly influenza and other vaccines in future. However, in other aspects ANC and PNC in many cases constitute 'missed opportunities' for women and babies themselves, with emerging evidence that the content and quality of ANC and PNC provided is poor and that this is not 'matched' to the burden of disease in women during and after pregnancy.[12,13]

We sought to identify the essential components of ANC and PNC and conducted a multi-country study to assess whether resources are in place to provide these to women who access care during and after pregnancy. As a secondary aim, we provide information to identify gaps in the health system which require strengthening to provide care that is of good quality.

2 | METHODS

This multi-country cross-sectional study was carried out in five low- and middle-income countries (LMIC): Afghanistan, Chad, Ghana, Tanzania and Togo.

2.1 | Selection of sites

In each country, the Ministry of Health (MOH) allocated the Regions or Districts to be included in the survey to ensure a representative pragmatic sample of healthcare facilities. Healthcare facilities in each designated district or region were selected for inclusion in the study if they in principle were expected to provide; (1) ANC and PNC and (2) Basic or Comprehensive Emergency Obstetric and Newborn Care (EmOC); (3) equal numbers of primary and secondary health care facilities were included where both levels were in place, and (4) those with the highest patient volume (for ANC, PNC and deliveries) were included for each category. Both rural and urban healthcare facilities were included (Table S1).

Healthcare facilities were considered to be secondary or tertiary (and denoted as secondary+) if they could admit inpatients for more than 24 hours. Primary healthcare facilities were those where longer term admission was not possible and included; basic health centres and family health houses in Afghanistan; health centres in Chad; health centres, polyclinics and maternity homes in Ghana; peripheral care units (Unités de Soins Périphériques – USP) and polyclinics in Togo; as well as cottage hospitals, primary health centres, health centres and dispensaries in Tanzania. Secondary+ healthcare facilities included district, provincial, regional and national hospitals in the five countries.

2.2 | Data collection tools

A structured questionnaire was developed which included key indicators from existing validated tools including; the Columbia University Averting Maternal Death and Disability (AMDD) tool,[14] WHO Quality of Care Standards,[15] WHO focused ANC essential elements and indicators[16] and WHO and UNICEF baby-friendly hospital initiative tool for PNC,[17] and WHO's Service Availability and Readiness Assessment.[18]

ANC and PNC are intervention packages or 'care bundles' with multiple components. For this study we used the term 'component' to denote individual interventions or actions that are considered part of the ANC and/or PNC care package. The terms 'core', 'key', 'vital' and 'essential' are used interchangeably in the literature. The term 'essential' is used in this study to denote a required component of ANC and/or PNC. In obstetrics, 'signal functions' are used to denote a representative shortlist of key interventions and activities that address major causes of maternal and perinatal morbidity or mortality. These were first used to define Emergency Obstetric Care with nine identified signal functions describing this care package.[14] A list of signal functions does not include every service that may need to be provided but are considered as representative of a minimum essential care package that needs to be in place.

The process of identification of the essential components of ANC and PNC included a systematic review of the literature (PROSPERO 2018 CRD42018107043 and CRD42018107054) and a series of seven consensus-building workshops with international stakeholders (two workshops) as well as with a wide range of stakeholders in each participating country (five workshops). In total, 15 main components (or 'signal functions') of ANC and PNC were identified (Table 1). Although ANC and PNC are generally considered as distinct care packages which are part of a continuum of care, some of the identified essential components are in principle provided both for ANC and for PNC (e.g. components 1–3, 4ii, 6ii, 13, 14).

For each component, the minimum set of consumables, drugs, equipment or activity required to deliver each identified component were identified by the main group of researchers (Table 1). As this may vary across countries, for each included country the specific components were subsequently checked against national guidelines and standards or recommendations for care including, for example, taking account of the recommended first-line treatment regimens (drugs) for malaria, TB, HIV and syphilis for both mothers and babies.

To assess the availability and quality of the main components of ANC and PNC, information was obtained on; (1) general infrastructure of the healthcare facility, (2) availability of human resources, (3) availability of equipment, testing kits and laboratory consumables, (4) availability of consumables including medicines and vaccines, (5) number of women attending for ANC and for PNC.

For each country, the assessment tool was reviewed with in-country partners and specialists, adapted to the local health system if needed, including for the level of healthcare for each type of healthcare facility, type and cadres of human resources, and guidelines for availability of types and levels of services. The final tool was then agreed and subsequently field-tested in each setting before use across each country.

2.3 | Data collection

The survey tool was uploaded onto electronic tablets for data collection using SURVEY CTO software.

A total of 118 data collectors across the five countries were trained using a standard format training package of 4–5 days, which included pilot-testing of the tool in each setting. Each included healthcare facility was subsequently visited by a dedicated data collection team (at least two data collectors per team). Information was obtained from; the head of the healthcare facility, heads of maternity services and healthcare providers. Availability of equipment, supplies and medicines was verified through direct observation.

The number of women attending for ANC and PNC was extracted through detailed review of facility registers and records based on a reference month. Assessments were conducted in English, French, Dari and Pashto. Data was sent to the CMNH-LSTM encrypted server at the time of data collection to allow for real-time quality assurance. Verification of data using automated and manual checks was used when

TABLE 1 ANC and PNC components, and the prespecified requirements for each individual component, assessed at each healthcare facility

ANC and PNC component		Requirements
1	Screening for pre-eclampsia	BP machine [and] stethoscope [and] urine multi-dipstick
2	Prevention, screening for and management of anaemia	(Hemocue® [or] Laboratory on site) [and] (Ferrous sulphate [and/or] Folic acid)
3	Prevention, screening for and management of malaria	Thermometer [and] (Rapid diagnostic test (RDT) [or] Laboratory on site) [and] Insecticide-treated bed nets [and] (Drugs for prevention [and] management of malaria, including Sulfadoxine-pyramethamine (SP) for prophylaxis [and] (ACT [or] Artesunate injectable [or] Arthemeter injectable for treatment of infection [or] as specified in national guidelines)
4i	Screening for and management of HIV in adults and babies	(-IV RDT [or] Laboratory on site) [and] HIV drugs for treatment for adults [and] HIV drugs for babies
4ii	Screening for and management of HIV in adults and babies (including PMTCT)	As above, plus PMTCT
5	Screening for and management of syphilis	Syphilis RDT [and] antibiotics for treatment
6i	Screening for and management of TB in mothers	(Sputum collectors with Laboratory on site [or] X-ray [or] GenXpert) [and] Drugs for treatment of TB, including ((HRZE quadritherapy [and] syrup for babies) [or] as specified in national guidelines) [and] BCG
6ii	Screening for and management of TB in mothers and babies	As above, plus (syrup for babies [or] as specified in national guidelines) [and] BCG
7	Prevention of tetanus in mother and baby	Tetanus toxoid vaccine
8	Assessment of body mass index (BMI)	Height measurement tool [and] weighing scale for adults
9	Assessment of post- and pre-term birth	Measuring tape [and] pregnancy wheel [and] examination couch [and] Ultrasound at secondary+ level only
10	Assessment of fetal wellbeing during pregnancy	Measuring tape [and] (Pinard stethoscope [or] doptone) [and] examination couch [and] Ultrasound at secondary+ level only
11	Detection of multiple pregnancy, abnormal lie and abnormal presentation during pregnancy	Measuring tape [and] doppler [and] Pinard stethoscope [and] examination couch [and] Ultrasound at secondary+ level only
12	Screening for gestational diabetes	Glucometer [or] Laboratory on site
13	Screening and counselling for mental health and domestic violence	Healthcare providers trained in mental health in the past 3 months
14	Offer contraception (family planning)	At least one of the following: condoms, pills (combined [and] progesterone only), Depo Provera for injection, implants, IUCD/S [and] Permanent contraceptive (vasectomy [and] tubal ligation) at secondary+ level only
15	Monitor growth of the newborn baby	Measuring tape [and] baby weighing scale

the data was received. Communication between the data management and field teams was then initiated for any queries raised in the review so as to allow data checks with the data collectors and, if necessary, with data sources. Any data revisions were then made as part of the cleaning process. Further data cleaning was done after data collection completion, which was not 'real-time'.

2.4 | Data analysis

Healthcare facilities were considered able to provide the relevant ANC or PNC component only if all the required resources were recorded to be in place. Descriptive analysis was performed, disaggregated by country and level of healthcare. To summarise the availability of ANC and PNC components, colour-coded dashboards were used, representing the proportion of the healthcare facilities with component available for each ANC or PNC component, as ANC or PNC component available in 0–25% of healthcare facilities (red), 26–50% (amber), 51–75% (yellow) and ≥76% (green). Data were analysed using R 3.5.1.[19]

3 | RESULTS

A total of 321 healthcare facilities were included, 207 delivering primary healthcare services and 114 secondary or tertiary (secondary+) healthcare services (Table 2).

Across the countries for the included healthcare facilities, a median and interquartile range [IQR] of 1668 [660–3792] women attend for ANC per year per healthcare facility with a much lower number attending for PNC (median 300 [48–864] per year). There are significant differences by level of healthcare provision, with more than double the number of ANC visits at secondary+ level versus primary level (3096

TABLE 2 Characteristics of included healthcare facilities ($n = 321$)

Country	Number of healthcare facilities			Ownership of facilities		Number of regions or districts assessed	Number of women per year per healthcare facility receiving ANC Median (IQR)			Number of women per year per healthcare facility receiving PNC Median (IQR)		
	Total	Primary	Secondary+	Public	Other[a]		All	Primary	Secondary+	All	Primary	Secondary+
Togo	62	54	8	48	14	3	1728 (972–3060)	1248 (744–2424)	4272 (2664–5472)	144 (48–360)	108 (48–300)	648 (480–1104)
Ghana	60	30	30	53	7	6	5076 (2280–11 820)	3360 (1104–5136)	10 200 (4908–16 500)	768 (288–2364)	444 (96–864)	2304 (756–3312)
Afghanistan	65	27	38	62	3	4	1560 (792–2580)	876 (432–1680)	1848 (1200–3888)	540 (168–1080)	264 (48–468)	840 (408–2376)
Chad	60	35	25	54	6	12	672 (192–1980)	1056 (432–1836)	372 (0–2052)	36 (0–156)	24 (0–72)	96 (0–408)
Tanzania[b]	74	61	13	67	7	2	1368 (732–2892)	1164 (684–2244)	4164 (3564–6864)	600 (288–1080)	504 (288–960)	1104 (684–3432)
Total	321	207	114	284	37	27	1668 (660–3792)	1248 (624–2424)	3096 (948–7995)	300 (48–864)	228 (48–552)	714 (96–2304)

[a]Including private or faith-based healthcare facilities.
[b]Includes 8 in Zanzibar (2 secondary and 6 primary) and 66 in Mainland Tanzania (11 secondary+ and 55 primary).

[948–7995] versus 1248 [624–2424]) and this is increased more than three times for PNC visits (714 [96–2304] at secondary+ level versus 228 [48–552] at primary level). There are also significant country differences, with healthcare facilities in Ghana having the highest numbers of ANC and PNC visits and Chad the lowest (Table 2).

3.1 | Availability of human resources

Overall, with the exception of five healthcare facilities (two in Afghanistan, two in Chad and one in Tanzania), all healthcare facilities have at least one qualified member of staff to provide ANC and PNC. There are a number of different cadres providing ANC and PNC within and across the countries, including specialist or non-specialist medical doctors, nurses/nurse-midwives/midwives or auxiliary nurses or midwives (Table S2). In general, 3–5 times more staff are available to provide ANC and PNC at secondary+ compared with primary level healthcare facilities. The majority of healthcare providers are nurse-midwifery cadres. Cadres classed as community health workers (CHW) are in place in Afghanistan, Chad and Togo.

3.2 | Availability of ANC and PNC components

Availability of each component of care was assessed for each healthcare facility as per the criteria set out in Table 1 and is presented by country and by level of the health system (Table 3, Tables S3 and S4).

Screening for pre-eclampsia was available in the majority of settings at primary and secondary+ levels (209 of 321 facilities [65.1%], 127 primary [61.4%] and 82 secondary+ [71.9%]). This component was least available in Chad and Afghanistan, in particular at primary level (33.3% in Afghanistan and 31.4% in Chad.

Prevention, screening for and management of anaemia was available in the majority of healthcare facilities (230 of 321 facilities (71.7%), 134 primary (64.7%) and 96 secondary+ level (84.2%) but was least available at primary level in Chad (42.9%) and Ghana (46.7%).

Prevention of, screening for, diagnosis and management of malaria was available in 144 facilities (44.9%), of the 321 facilities assessed in the five countries and in 94 primary (45.4%) and 50 secondary+ (43.9%) healthcare facilities. In Afghanistan this included 27 facilities (41.5%) (at primary [37%] and secondary+ [44.7%] levels). In malaria-endemic countries such as Chad this was available in only 11.7% healthcare facilities overall and in Togo in 9.7% of healthcare facilities overall. In Ghana 80% and in Tanzania 75.7% of healthcare facilities had this component in place.

Screening for and management of HIV$^+$ women and babies was available in 139 of the 321 facilities (43.3%) almost equally at primary (89, 43%) and secondary+ levels (50, 43.9%). Significant variation in availability was seen by

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TABLE 3 Availability of ANC and PNC components across five countries—all included healthcare facilities (n = 321)

		Afghanistan (n = 65)	Chad (n = 60)	Ghana (n = 60)	Tanzania (n = 74)	Togo (n = 62)	Total (n = 321)
	ANC and PNC components	%	%	%	%	%	%
1	Screening for pre-eclampsia	46.2	48.3	80	68.9	82.3	65.1
2	Prevention, screening for and management of anaemia	80	60	56.7	86.5	71	71.7
3	Prevention, screening for and management of malaria	41.5	11.7	80	75.7	9.7	44.9
4i	Screening for and management of HIV$^+$ women and babies	3.1	11.7	51.7	93.2	48.4	43.3
4ii	Screening for and management of HIV$^+$ women and babies including PMTCT	3.1	11.7	51.7	86.5	48.4	41.7
5	Screening for and treatment of syphilis	86.2	66.7	85	94.6	71	81.3
6i	Screening for and management of TB in adults	76.9	33.3	36.7	60.8	30.6	48.6
6ii[a]	Screening for and management of TB in adults and babies	7.7	NA	0	NA	0	2.7
7	Prevention of tetanus in mother and baby	89.2	71.7	80	98.7	51.6	79.1
8	Assessment of BMI	86.2	66.7	93.3	91.9	77.4	83.5
9	Assessment of post- and pre-term birth	9.2	20	40	16.2	38.7	24.3
10	Assessment of fetal wellbeing during pregnancy	16.9	18.3	33.3	12.2	16.1	19.0
11	Detection of multiple pregnancy, abnormal lie and presentation during pregnancy	16.9	18.3	33.3	12.2	16.1	19.0
12	Screening for gestational diabetes	86.2	70	88.3	64.9	77.4	77
13	Screening and counselling for mental health and domestic violence	24.6	5	25	4.1	0	11.5
14	Offer family planning services (contraception)	58.4	66.6	36.7	95.9	90.7	70
15	Monitor newborn growth	90.8	80	95	86.5	77.4	86.0

Red: 0–25%; Amber: 26–50%; Yellow: 51–75%; Green: 76–100%. NA: information not collected. All facilities = 187, primary = 111, secondary+ = 76.

[a]The totals for this SF exclude Chad and Tanzania.

country; in Afghanistan overall, this was 3.1% (all at secondary+ level), in Chad 11.7%, in Togo 48.4%, in Ghana 51.7% and in Tanzania 93.2%.

If prevention of mother to child transmission (PMTCT) as a component of management of HIV$^+$ women was included, availability was documented in 134 of the 321 facilities (41.7%), with similar distribution between primary and secondary+ facilities (84, 40.6% versus 50, 43.9%, respectively). The country-specific proportions remain varied, with 3.1% facilities in Afghanistan (all at secondary+ level), 11.7% in Chad, 48.4% in Togo, 51.7% in Ghana and 86.5% in Tanzania.

Screening for and treatment of syphilis was available in 261 facilities (81.3%) (149 primary [72%] and 112 secondary+ [98.3%] levels). The least availability was at primary level in Chad, at 45.7%.

Screening for and management of TB: If considered for adults only this was available in 156 healthcare facilities overall (48.6%) but significantly more often in secondary+ level healthcare facilities, with 68 primary (32.9%) and 88 secondary+ level (77.2%) facilities able to offer this component of care. Screening for and management of TB in babies as well as adults was, however, available in only five (2.7%) healthcare facilities overall—all in Afghanistan (two of 27

[7.4%] healthcare facilities at primary level and three of 38 at secondary+ level [7.9%]) of the 187 facilities (111 primary and 76 secondary and above) assessed in the three countries assessed. This was because of a lack of availability of treatment for TB in babies. Availability of medication for TB treatment in babies was not assessed in two countries (Chad and Tanzania).

Prevention of tetanus in mother and baby: Tetanus toxoid was available in 254 (79.1%) healthcare facilities overall: 163 (78.7%) at primary and 91 (79.8%) at secondary+ level.

Assessment of height and weight to establish body mass index (BMI) was possible in 268 (83.5%) healthcare facilities and almost equally available at primary (167, 80.7%) and secondary+ (101, 88.6%) levels.

Assessment of pre- and post-term birth: Gestational age could be assessed in only 78 facilities overall (24.3%): 29 at primary (14%) and 49 at secondary+ (43%) level.

Assessment of fetal wellbeing during pregnancy was possible in only 61 facilities (19%): 14 at primary (6.8%) and 47 at secondary+ (41.2%) level.

Screening for multiple pregnancy, abnormal lie and presentation during pregnancy could be conducted in fewer than one in five healthcare facilities; overall in 61 of 321 healthcare facilities (19%): 14 at primary (6.8%) and 47 at secondary+ (41.2%) level.

Availability of ultrasound scanning: As part of the assessment of availability of requirements for key components of ANC, we assessed availability of an ultrasound scan. This was available in 121 of 321 (37.6%) healthcare facilities overall: 79 of 114 (69.3%) at secondary+ level and 42 of 207 (20.2%) at primary level. This was <10% at primary level In Afghanistan, Chad and Tanzania, but 53.3% of primary level healthcare facilities in Ghana and 33.3% in Togo had an ultrasound scan available. At secondary+ level this was lowest in Afghanistan (44.7%) but available in the majority of facilities in Chad (72%), Togo (75%), Tanzania (84.6%) and Ghana (90%).

Screening for gestational diabetes was possible in 247 healthcare facilities (77%): in 133 primary (64.3%) and all 114 (100%) secondary+ level healthcare facilities.

Screening and counselling for mental health and domestic violence: Training received in mental health was used as a proxy measure to assess the availability of this component of ANC and PNC, which was considered available in a total in 37 facilities (11.5%): 13 primary (6.3%) and 24 secondary (21.1%).

Contraception or family planning methods were available in 225 healthcare facilities (70%). These were considered in place at 172 primary healthcare facilities (83%). For secondary+ level facilities, family planning services were only assessed as being available if permanent methods (tubal ligation, vasectomy) could be provided and only 53 of the 114 secondary+ level healthcare facilities (46.5%) met this criterion. However, 78.9% could provide the other aspects of family planning.

The ability to monitor newborn growth was available across most healthcare facilities, in total 306 facilities of the 321 facilities assessed in the five countries (95.3%): 194 primary (93.7%) and 112 secondary+ level (98.2%).

3.3 | Summary of availability for all essential components of ANC and PNC

Across all countries, for all components of ANC and PNC, only five of 15 components were available in more than 75% of healthcare facilities: (1) diagnosis and management of syphilis, (2) prevention of tetanus in the mother and baby, (3) estimation of BMI in the mother, (4) screening for gestational diabetes and (5) monitoring of growth in the newborn baby (Figure 1). Conversely, of the 15 essential components, five were available <25% of all healthcare facilities: (1) prevention and management of TB in adults as well as babies (mainly due to lack of availability of medication for babies); (2) ability to assess pre-term or post-term birth (mainly because of inability to determine gestational age during pregnancy), (3) assessment of fetal wellbeing (including heart rate detection); (4) detection of multiple pregnancy, abnormal lie and presentation; and (5) screening and counselling or support for mental health and domestic abuse.

For the prevention screening and management of malaria with an overall availability in 44.5% of healthcare facilities surveyed and a range of 9.7–80% in endemic countries, in only two countries (Ghana and Tanzania) was this available in >75% of healthcare facilities. Similarly, for HIV screening and management including PMTCT, only Tanzania had this available in >75% of healthcare facilities.

Availability is generally better at secondary+ level than at primary level, with the exception of family planning (83% versus 46.4%) and prevention, screening for and management of malaria, where lower level facilities offer a marginally better availability (45% versus 44%) (Figures S1). Key differences at secondary+ versus primary level observed were for the screening and management of TB in adults, with 77.2% versus 32.9%; assessment of fetal wellbeing, multiple pregnancy and abnormal lie, and screening for gestational diabetes—both with around 40% availability at secondary+ level versus 6.8% at primary level.

Variation was also observed between countries. Chad had the least number of components available, with 25% or fewer healthcare facilities having 7 or less out of 15 key components in place. Conversely, more than 75% of healthcare facilities surveyed in Tanzania were able to provide eight or more of the 15 key components.

4 | DISCUSSION

4.1 | Main findings

A minimum essential ANC and PNC care package or 'bundle' was identified with a total of 15 essential key components or 'signal functions'. These are expected to be available to women during and after pregnancy, for ANC and PNC to be

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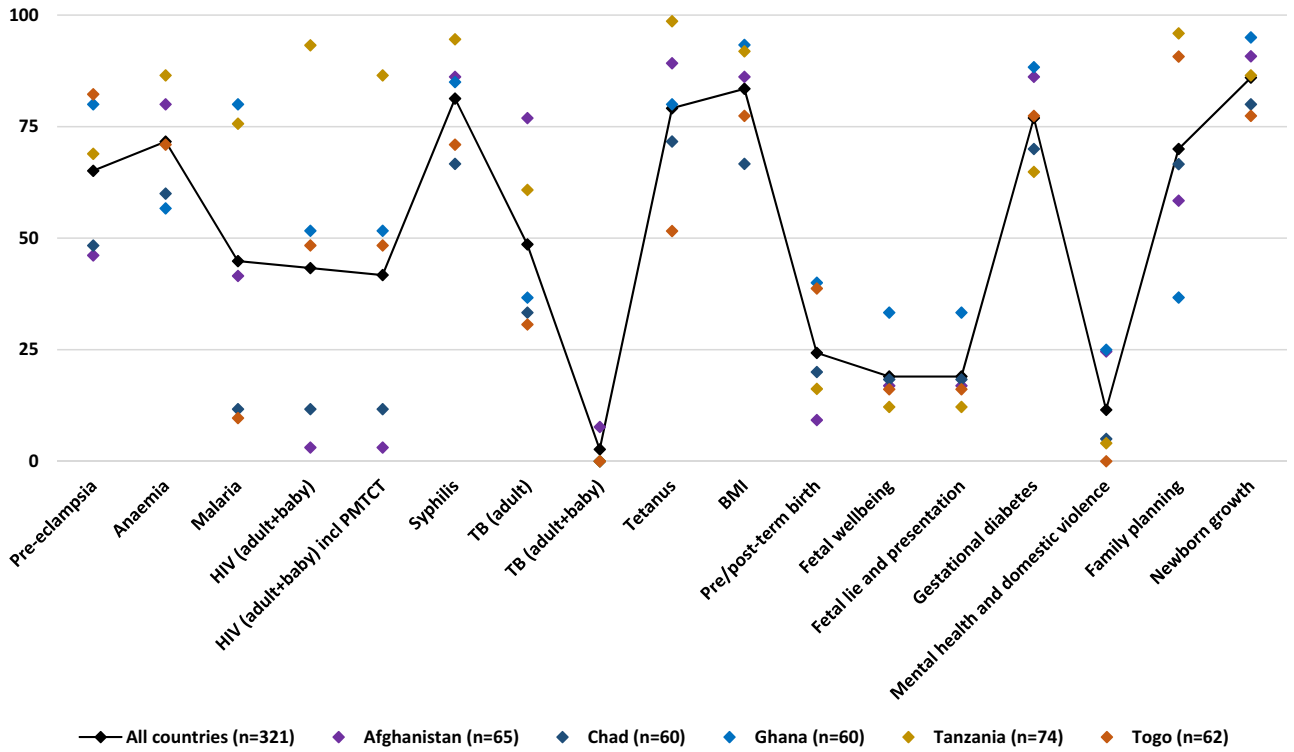

FIGURE 1 Availability of all essential components of ANC and PNC for all healthcare facilities combined and by country

considered as 'in place'. Assessment of healthcare facilities at primary level and upwards across five low- and middle-income countries demonstrates that none of the healthcare facilities assessed could provide all 15 identified essential components of ANC and PNC. Key obstetric components, including assessment of gestational age, fetal wellbeing and detection of multiple pregnancy, abnormal lie and presentation could be provided in less than 25% of all healthcare facilities assessed. For malaria, TB and HIV, the availability of components even in high-endemic countries in Sub-Saharan Africa was 'patchy' at best. Screening for HIV and management of HIV^+ women and babies including PMTCT was available in 11.5–86.7% of facilities in the Sub-Saharan African countries, screening, prevention and treatment of malaria was available in >75% of healthcare facilities in two of the four endemic countries (Ghana and Tanzania), and screening for and management of TB in mothers and babies was almost never in place. Across all settings, more care components are available at higher- than lower-level healthcare facilities. Contrary to what is recommended, the number of women attending for ANC and PNC is generally higher at secondary+ than at primary healthcare facilities (ratio of 2.5:1) and there are also significantly more staff able to provide care at secondary+ versus primary level healthcare facilities (ratio of 3.3:1). The number of women attending for PNC is comparatively much lower.

4.2 | Strengths and limitations

A key strength of the study is the identification and assessment of all of the key essential components of ANC and PNC representing a minimum essential care package that needs to be in place to meet the health needs of women and babies during and after pregnancy. The focus was to a large extent on the availability (or not) of these 15 components, and any of the identified components of care was only considered available if there was on-site direct observation and verification that all required elements to be in place. In addition, in-depth on-site surveys were conducted to assess each of the health system elements required to be able to provide these.

We included all or a relevant sample of primary-level healthcare facilities in each district, selecting those with the highest patient volume. This was to ensure clear inclusion criteria which could be applied across all settings and because we sought to look at the content of services that were accessed by the majority of women and their babies rather than services provided at healthcare facilities that received very few or no patients. We appreciate that healthcare facilities with lower patient numbers may have been less functional and/or may have been those situated in areas with a sparser population density and/or those that were harder to reach for women.

Although the study assessed whether the essential components of the ANC or PNC care package were available and was reported as being provided, it was not possible to assess 'how' that care was provided in more detail (i.e. the process), nor were the experiences of women who attended for care assessed. This would have required more in-depth mixed-methods studies in each setting, which will be conducted in future research. The availability of any of the components of care does not in itself imply this component was provided in accordance with quality standards. However, we argue

that without availability of content (the essential component being in principle in place) there can be no assessment of the quality of care received or process of providing this.[20–22]

We considered intrapartum care as a separate care package which is generally described as 'Skilled Birth Attendance' and mostly provided at those healthcare facilities which also have a labour room as an in-patient rather than via an outpatient consultation. We consider the requirements and essential components for Skilled Birth Attendance as specific to those for ANC or PNC, except for 'immediate postnatal care', which is provided after birth.[23–25]

4.3 | Interpretation

The number of women who access care during and after pregnancy varies across countries. However, as assessed in the last World Health Statistics Report to specifically do so (2016), the vast majority of women access a healthcare facility on at least one occasion for ANC; for countries included in this study, this comprises 96.9% of women in Ghana, 97.5% in Tanzania, 92.3% in Togo, 62.5% in Chad and an estimated 59.8% in Afghanistan.[4] With an absence of content of care this will largely constitute an enormous and shocking missed opportunity to prevent and address the health needs of women. With women as the main care seekers, this is also a missed opportunity for the family as a whole. There is a recognised need to improve access to, and coverage with care especially for women living in more rural and/or less densely populated settings. The proportion of women who attend for ANC is one of the indicators measured to assess level of universal health coverage.[2,26] It will certainly be important to continue to monitor this indicator and provide disaggregated information for rural and urban areas, by vulnerability group, and including by wealth category of women. Perhaps more importantly it is now time to not only consider the number of women receiving care and the frequency of attendance, but to look also at the content of care received.[12,13,27,28]

There has been some debate regarding the use of ultrasonography during pregnancy, especially in low-resource settings and/or as part of a minimum service package. Ultrasonography can be a helpful and often essential tool, for example to assess fetal and placental lie and position, confirm multiple pregnancy and confirm fetal demise if this occurs *in utero*. Gestational age and an estimated date of delivery is best established in the first trimester with the help of ultrasound scan dating.[29–31] The effectiveness for the detection and subsequent management of fetal growth retardation or compromise is less well established. We note, however, that in many settings ultrasonography is now available in seven of 10 secondary+ level and one in five primary level healthcare facilities assessed in this multi-country survey. A recent study shows that, although ultrasonography was reported as widely available, antenatal detection of fetal anomalies remains highly variable across low- and middle-income countries.[32] It is possible that our assessment of ultrasonograhy as essential only at secondary+ level is too conservative, and it could be argued that ultrasonography should now be considered as required to be available at all levels. The next step will be to ensure ultrasound is used in the right way and for the right reasons. This will require urgent further attention, especially with regard to training of all relevant levels of healthcare providers to ensure competency in the correct and ethical use of ultrasonography during and after pregnancy and the development of clinical guidelines and referral pathways.

A key 'building block' of the health system is human resources. Worldwide there is a shortage of human resources.[33,34] This study illustrates that although at each level there are human resources in place, these are at bare minimum and will be insufficient if uptake and/or content of ANC and PNC increases further. There is also generally a lack of staff trained and competent to provide basic content and more specifically to support and manage women with complicated pregnancies. Recently there have been suggestions that community-based healthcare workers and/or volunteers may be better placed to provide postnatal care and follow-up.[35,36] Although this is likely to be cost-effective and may result in more women receiving a visit in the postnatal period, careful planning is needed for effective implementation [37,38] A multi-country mapping shows that few community-based healthcare providers are adequately trained and competent, legislated and/or supported to provide all of the essential components of either ANC or PNC.[39,40]

4.4 | Implications for practice and research

For each component of ANC and PNC, a composite measure was used to assess its availability (or not). This means that all of the elements identified as necessary had to be in place for that component to be assessed as available as part of service delivery (as set out in Table 1). Non-availability does not therefore mean that no part of the care was available, e.g. with even one aspect missing (such as a thermometer to check temperature for screening of malaria) the whole component of care would be assessed as not in place. This analysis focuses on a set of minimum standards as an aspirational benchmark and to ensure safe and high-quality care is provided (e.g. a fever is not diagnosed unless confirmed through a measurement of body temperature). Similarly, it must be noted that this survey highlighted that in some countries it is currently not agreed practice or policy to provide all of the essential components e.g. treatment for TB in neonates may not be required to be available at primary healthcare level. Findings of this study were disseminated widely and discussed with stakeholders at all levels including at the respective Ministries of Health and with UN partners. It is hoped this will help re-formulate policy where required so that identified gaps in content of ANC and/or PNC can be addressed in future.

There are currently no internationally agreed 'signal functions' for ANC and PNC. We propose that the identified

essential components of care as defined and assessed in this study be adopted to serve as 'signal functions' of ANC and PNC for wider use. Although already adopted by the GFATM and national governments and research partners involved in this study, this will require further dissemination and discussion with other national and international stakeholders. Rigorous evaluation across more settings is needed to establish whether and why content of care is lacking and to identify which of the required structural or health systems factors (including human resources, equipment and supplies) require strengthening.

Recent studies report a high burden of illness in women living in low- and middle-income countries during and after pregnancy. Women expect healthcare providers to be able to provide advice as well as diagnostic and therapeutic care that is sympathetic to a woman's needs and situation.[41,42] The proposed signal functions were not developed specifically in response to assessments of burden of disease in each setting but as representative of the agreed healthcare packages to be provided in each setting to all pregnant women and their babies as part of 'routine' care. As better assessments of burden of disease become available, the ANC and PNC care packages may require modification. Integration of care across the various components of ANC and PNC including taking into account family planning needs and the main infectious diseases (malaria, TB, HIV/AIDS and syphilis) is of critical importance to enhance women's experiences of care and to ensure no loss to follow-up, and effective use of limited resources, including human resources. A renewed focus on strengthening the ANC and PNC platform, building on existing efforts and opportunities to identify and address the burden of disease comprehensively across the main current and emerging diseases such as COVID-19 will facilitate further integration.

With the provocative question 'Where is the M in MCH?', Rosenfield and Maine reawakened consciousness about the risk of maternal mortality in developing countries.[43] We similarly ask: Where is the C in ANC and PNC? We seek to re-awaken consciousness regarding the need for content of ANC and PNC if these important care packages are to be effective. We propose clearly defined signal functions to be used for the assessment and monitoring of content of ANC and PNC.

5 | CONCLUSIONS

Despite a large number of women accessing care during and after pregnancy in many countries, this study shows that the essential components of ANC and PNC are often not in place. There is an urgent need to address this gap and to optimise opportunities when women access care, in order to prevent illness and adverse pregnancy outcomes, meet the health needs of mothers and babies, improve trust in the health system, and increase equitable healthcare coverage. Only then can ANC and PNC lead to a positive experience of pregnancy and childbirth for all.

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CONFLICT OF INTERESTS

Completed disclosure of interest forms are available to view online as supporting information.

AUTHOR CONTRIBUTIONS

Design: BM, NF, VM, NvdB. Data collection and oversight in-country: BM, SG, AQ, SF, DB, AWY, AJR, GK, J-PG, HK, SAA, MM, MS, AO, AE, RM, AA, GK. Analysis: BM, SG, AQ, SF, AT, MM, NF, VM, NvdB. Manuscript writing: BM, SG, AQ, SF, AT, DB, AWY, AJR, GK, J-PG, NDR, HK, SAA, MM, MS, AO, AE, RM, AA, GK, NF, VM, NvdB.

ETHICS APPROVAL

Ethical approval was obtained from the Liverpool School of Tropical Medicine Research Ethics Committee (LSTM:17-034), the Afghanistan National Public Health Institute Review Board (ANPHI IRB) (43922), the Chadian National Committee for Bioethics (Comité National de Bioéthique Tchadien – CNBT) (138/PR/MESRT/sc/cNBTt2ola), the Ghana Health Service Ethics Review Committee (GHS ERC) (GHSERC008/09/17), the University of Dodoma Institutional Research Review Committee UDOM/REC/63-28.11.2018) and the Zanzibar Health Research Ethical Committee (ZAHREC) (NO. ZAHREC/02/DEC/2018/7) in Tanzania, as well as approval from the MoH in Togo (1521/17/MSPS/CAB/SG/DGAS/DESR).

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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