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Series: Who cares for women? Towards a greater understanding of maternal and reproductive healthcare markets

Using multi-country household surveys to understand who provides reproductive and maternal health services in low- and middle-income countries: a critical appraisal of the Demographic and Health Surveys

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Abstract

OBJECTIVE The Demographic and Health Surveys (DHS) are a vital data resource for cross-country comparative analyses. This study is part of a set of analyses assessing the types of providers being used for reproductive and maternal health care across 57 countries. Here, we examine some of the challenges encountered using DHS data for this purpose, present the provider classification we used, and provide recommendations to enable more detailed and accurate cross-country comparisons of healthcare provision.

METHODS We used the most recent DHS surveys between 2000 and 2012; 57 countries had data on family planning and delivery care providers and 47 countries had data on antenatal care. Every possible response option across the 57 countries was listed and categorised. We then developed a classification to group provider response options according to two key dimensions: clinical nature and profit motive.

RESULTS We classified the different types of maternal and reproductive healthcare providers, and the individuals providing care. Documented challenges encountered during this process were limitations inherent in household survey data based on respondents' self-report; conflation of response options in the questionnaire or at the data processing stage; category errors of the place *vs.* professional for delivery; inability to determine whether care received at home is from the public or private sector; a large number of negligible response options; inconsistencies in coding and analysis of data sets; and the use of inconsistent headings.

CONCLUSIONS To improve clarity, we recommend addressing issues such as conflation of response options, data on public *vs.* private provider, inconsistent coding and obtaining metadata. More systematic and standardised collection of data would aid international comparisons of progress towards improved financial protection, and allow us to better characterise the incentives and commercial nature of different providers.

keywords demographic and health surveys, reproductive health, maternal health, private sector, methods, healthcare providers

Introduction

The Demographic and Health Surveys (DHS) Project has conducted over 300 nationally representative surveys in more than 90 low- and middle-income countries (LMICs) since 1984 [1]. The DHS are a vital data resource for

national and international policymakers, project implementers and researchers, providing high-quality data for policy and programme development, monitoring and evaluation (Box 1). Although the surveys are designed to be comparable across countries, each country can adapt its survey to suit its national context and information

Box 1 DHS Surveys

The DHS are cross-sectional nationally representative household surveys, usually covering 5000–30 000 households [1]. They use standard model questionnaires, which countries can adapt by adding optional modules, questions or response options. Manuals and technical assistance ensure that the survey procedures followed in each country are similar, allowing data to be compared across countries. Surveys are normally conducted over 18–20 months, with several months of data collection. Descriptive survey results are published in final reports, and data sets are available online through a process of electronic registration. DHS respondents are women of reproductive age (15–49 years), and men are interviewed in many countries. The surveys include questions on household and individual characteristics, fertility, maternal and child health, mortality, nutrition, gender, HIV and malaria. It is also typical for DHS surveys to include multiple biomarker tests or measurements (such as anthropometry, HIV, anaemia and malaria).

needs, ensuring the relevance of data for in-depth country-level analysis. Another key use of DHS data is cross-country analysis, which can be used to benchmark progress and evaluate potential policy impacts. However, challenges exist for carrying out cross-country comparisons using DHS data, which are reflected by their limited use for this purpose [2]. These challenges include the different years in which data are collected in various countries, different recall periods and the variability of samples of women (ever-married or all) [3].

This study forms one of a set of analyses comparing family planning, antenatal and delivery care services across 57 DHS countries. Our analyses assessed the types of providers being used for reproductive and maternal health care, in terms of whether they are public or private, and their level of clinical training. We focussed on these characteristics as they may determine the potential for health systems to expand coverage and improve quality and equity of care. For family planning, the extent of clinical training of providers is likely to determine the range of methods available, as methods such as sterilisation, implants and IUDs require a certain level of skill. For delivery care, the clinical level of the provider is integral to the safety and quality of care provided, and global goals aim for all women to deliver with a skilled birth attendant [4], with a defined set of skills [5]. For antenatal care, the accepted level of clinical training required is

less than for delivery care. The skill level of providers can also help capture information about costs and efficiency at the health system level, for example whether the provider's skill level is appropriate for the family planning method being provided, or whether there is potential for task sharing. Meanwhile, the profit motive of providers, whether public, not-for-profit or commercial in nature, may determine the accessibility and distribution of outlets, the costs to individual users, the potential to regulate services and the incentives that providers face.

In this study, we examine some of the challenges we encountered when comparing sources of health care across countries using DHS data. Taking these limitations into account, we present the classification we used in our analysis and provide recommendations that might enable more detailed and accurate assessment of providers in future work. The DHS has a continuing process of user feedback through its Questionnaire Review Portal on the DHS user forum (<http://userforum.dhsprogram.com/>), and the recommendations we present are intended to be part of such ongoing discussions.

Challenges in using source of care data for cross-country comparisons

To compare sources of care, we used the most recent DHS surveys conducted between 2000 and 2012; 57 countries had data available on family planning and delivery care and 47 countries had data available on antenatal care (Appendix 1). We analysed five questions, shown in Table 1, which ask respondents where they received care, and, for antenatal and delivery care, who provided it. We used these questions to understand the clinical training of the person providing care, the level of facility and the public or private nature of the provider.

Every possible response option for these questions across the 57 countries was listed and categorised, according to our classification described in detail below. This allowed us to identify challenges for cross-country comparisons of sources of care, and potential weaknesses in the response options and headings currently used in the DHS. We now examine these challenges in greater detail in turn.

Limitations of household survey data

First, it is important to acknowledge some complexities in using household survey data to assess where women are receiving care, particularly when making comparisons across countries. Data are based on respondents' self-report. The quality of these data therefore depends in the first instance on the respondents' knowledge of the source

Table 1 DHS questions relevant to source of reproductive and maternal health care

No	Question	Example of DHS headings* (these vary by country)	Our classification
1	Where did you obtain your current family planning method the last time?	Public Private medical Other	Public medical Public non-medical Private retailer Private specialised drug seller Private medical Faith-based (FBO) NGO Other (sector not known)
2	Did you see anyone for antenatal care for this pregnancy?	Health professional Other health personnel Other person	Doctor Nurse/midwife Auxiliary midwifery staff Auxiliary staff Traditional birth attendant Community health worker Traditional practitioner General facility staff Husband/friend Other No one
3	Where did you receive antenatal care for this pregnancy?	Home Public Private medical Other	Home (sector not known) Public Private other Private professional Private specialised drug seller Faith-based (FBO) NGO Other (sector not known)
4	Who assisted with the delivery of your last birth?	Health professional Other health personnel Other person	Doctor Nurse/midwife Auxiliary midwifery staff Auxiliary staff Traditional birth attendant Community health worker Traditional practitioner General facility staff Husband/friend Other No one
5	Where did you give birth to (child's name)?	Home Public Private medical Other	Home (sector not known) Public facility Private facility Private professional Private other Faith-based (FBO) NGO Other (sector not known)

*Interviewers are instructed to probe the respondent to determine the correct sector heading for the provider. For example, if a respondent states they gave birth in a hospital, the interviewer should ask whether the hospital was public or private, and then select the appropriate response option. In more recent questionnaire versions, interviewers are asked to note the name of the provider if they are in doubt about which heading or response option to use.

of care, but also on their correct recall of this information, for up to 5 years after the pregnancy or delivery. Respondents may not accurately recall where they

received care or whom they saw, particularly when complex subtypes of providers are difficult for respondents to distinguish. For example, non-governmental organisation

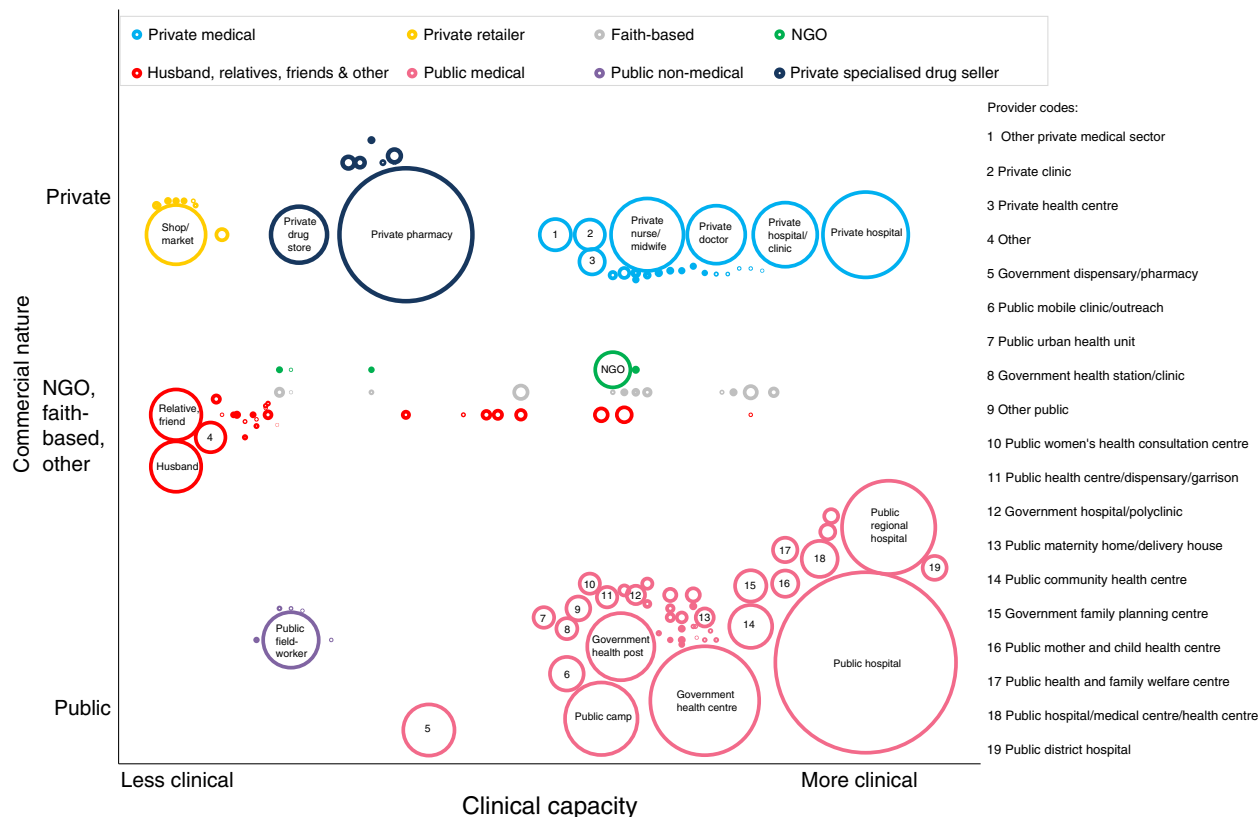


Figure 1 Typology of family planning providers, by category and market size (population-weighted).

(NGO) providers may not be accurately identified if they are not strongly branded or if they are working through the public sector or commercial providers. This may explain the apparently small role of NGOs in providing modern family planning methods, as seen in Figure 1. It is also likely to be difficult for many women to provide the exact level of clinical qualification of a care attendant, for example to tell the difference between nurses and midwives. Finally, even if respondents do recall the provider and accurately identify their clinical level or sector, there is an additional challenge for cross-country comparisons as terminology varies across countries, meaning the same survey response option may be used for providers with very different levels of training and responsibilities.

Issues such as respondent knowledge and recall are widely acknowledged and very difficult to address in a household survey. Although validation studies can assess the extent to which data validity is constrained by knowledge and recall, there are limited options for redress. However, a number of additional challenges

were uncovered during our analyses, many of which could be better addressed by the DHS to encourage usability and maintain high data quality for cross-country comparisons of sources of reproductive health care. While the majority of the content of DHS surveys is uniform and well-standardised across countries, it is particularly difficult to achieve comparability on sources of health care. The challenges we encountered are therefore specific to those variables outlined below (Table 1).

Conflating response options

Response options are conflated in different ways in each country. In some cases, this is due to the response options on the questionnaire itself, such as 'public hospital/medical centre/health centre' (Gabon) and 'private hospital/clinic' (Egypt). In other countries, the response options seem to have been conflated at the data processing stage, and only the conflated response options are available to data users. Conflating response options causes problems

when professionals that are likely to have different levels of skill are grouped in different ways in different surveys. Nurse/midwife is a response option that appears in 43 of the countries. In some countries, the category ‘nurse/midwife’ has been created by grouping the individual response options of ‘nurse’ and ‘midwife’, while in other countries nurse–midwife is the title of a formally recognised profession. The grouping of nurses and midwives that are not nurse–midwives therefore complicates this distinction, and forces the two types of health professionals to be grouped together when they may have different competencies. Occasionally, the range of competencies is even more extreme, with lower-skilled professionals added to the mix (e.g. nurse/medical assistant; auxiliary nurse midwife/nurse/midwife/lady health visitor; nurse/midwife/lady health visitor). In some cases, this is a response to the complexity of health worker qualifications in country; for example, in India and Pakistan, Lady Health Visitors (LHVs) are trained as nurses, midwives or auxiliary nurse–midwives, so it would not be possible to know the exact qualifications of an LHV even if they had a separate category.

Category error: place *vs.* professional and lack of information on sector of care

For both delivery and antenatal care, the DHS questionnaire asks who the woman saw (questions 2 and 4 in Table 1) and where they received care (questions 3 and 5). A flaw in the current response options is a category error for the question on where respondents received care, whereby in some countries, response options include types of health professionals, often with their sector, such as ‘private nurse’, ‘private doctor’ or ‘public health professional’. Ensuring that the responses to these questions consistently capture the type of setting (such as private doctor’s clinic) would enhance the completeness and comparability of the data collected.

A different, but related, issue occurs when antenatal or delivery care are given by a skilled, formal-sector provider, but take place in a home, such as the respondent’s home, rather than in a facility. In such cases, information is present on both the clinical training of the care giver and the location of care, but not the public or private sector of the care. For example, delivery care provided at home by a midwife or antenatal care provided by a community health worker could easily be public sector, or private sector, including NGOs. The issue of not being able to determine the public or private sector nature of provision also arises when women report they get their modern contraceptives from their partners, relatives or friends.

There are also a number of issues which do not effect data quality but limit the practical use of the data. As noted above, the DHS are a rich resource for cross-country comparisons, but have been somewhat under-used for this purpose. Addressing some of the following may benefit the usability and impact of the data across countries.

Large number of negligible response options

Countries have the flexibility to define their own response options, which ensures that data meets specific host-country needs. However, this results in a very high number of unique response options used across countries. Within the 57 surveys, we identified 141 unique family planning provider response options. Many of these options make up a very small proportion of responses – 58 response options were not used by more than 1% of respondents in any country. 64 response options were used in only one country, and in 36 of these, the response was chosen by less than 1% of women. We also identified 50 unique types of delivery locations, 91 unique types of persons conducting deliveries (including ‘no one’), 79 unique response options describing where antenatal care was obtained and 52 response options for the person providing antenatal care. While it is valuable for countries to be able to tailor response categories to their own context and to be able to conduct analysis at the level of granularity they require, this does create complications for cross-country analysis.

Coding and analysis of data sets

Even when the meaning of the unique response options is understood, consolidating DHS data sets across countries is an extremely labour-intensive process owing to how the variables capturing respondents’ answers are presented and coded. Firstly, numeric codes for responses to questions 1 and 5 (Table 1) differ across data sets. For example, code 32 in the variable describing place of delivery for the most recent birth in the recall period (variable m15_1) corresponds to ‘religious hospital’ in Benin, to ‘private doctor’ in Egypt, to ‘private health centre’ in DRC, to a location ‘abroad’ in Jordan, and to ‘FPAN (NGO)’ in Nepal. Each of these response options belongs to a different provider category in our classification.

Secondly, while the DHS attempt to standardise variable names across countries, there are occasions when variables appear in inconsistent locations in the data set. For example, there are numerous variables titled m57*_ (birth number), which tell us where women received

antenatal care. The ‘*’ is replaced by a letter ranging from ‘a’ to ‘x’, each capturing a different response option, as the question has multiple-choice answers. Variables for all letters in this range are usually present in data sets; but not all are needed in the majority of countries. In Tanzania, for example, from the 22 available letters, eight are unused. However, the response ‘public dispensary’, one of the largest sources of antenatal care in Tanzania, is held in a different variable entitled s408f, which is located among the country-specific variables. If data users assumed that all response options for this question were found in variables m57*, they would underestimate the antenatal coverage in Tanzania by half. To avoid this type of error when there are more response options than allocated variables, the most frequently used responses should be prioritised for listing in the usual location, only leaving the least used to the country-specific variable list at the end of the dataset.

As mentioned above, a challenge for our five questions is that response options mean different things in different contexts, a difficulty which has been noted previously for skilled attendance [6]. However, in some cases, the response options in data sets are not those used in the questionnaire itself. Instead, response options seem to have been recoded during data processing, further complicating the issue. For example, ‘MCH aides’ in the Sierra Leone survey, and ‘parteras’ in the Nicaragua survey have both been recoded as ‘auxiliary midwife’ in the data sets, although they are very different types of provider. In Sierra Leone, ‘MCH aides’ are part of the formal health system and are expected to conduct uncomplicated deliveries and give basic emergency obstetric care to complicated deliveries [7]. By contrast, ‘parteras’ in Nicaragua can either be trained health professionals, or traditional birth attendants that conduct deliveries in domestic environments, tend to be illiterate without primary education and are not permitted to conduct deliveries [8]. This again links to the complexity of health worker cadres, as even within the same country, health professionals with the same title can have very different meanings.

Finally, an important issue arises when assessing the coverage of antenatal care. DHS data sets do not contain a variable which holds a binary value for whether a woman received antenatal care or not. In survey reports, antenatal care coverage is measured by the proportion of births that were preceded by antenatal care from a skilled provider (the definition of which varies by country). The data sets contain numerous binary variables to the multiple-choice questions related to the provider and person providing antenatal care (questions 2 and 3, Table 1), and the total number of ante-

natal care visits during the pregnancy. However, they also contain several variables capturing whether specific elements of antenatal care were received, such as whether the respondent was weighed, had blood pressure taken, urine and blood tests conducted, tetanus toxoid received and malaria prophylaxis provided. These questions are not always consistent. Analysis of the coverage of births preceded by antenatal care must therefore rely on various algorithms guiding the decision as to whether a particular woman received antenatal care, depending on which of these variables (or combinations thereof) is considered, potentially resulting in different coverage estimates.

Inconsistent headings

As mentioned above, our analyses involved categorising different types of providers into meaningful groups based on their public or private nature and their clinical level. There is currently little agreement over the best ways of grouping provider types. We found 34 unique studies that undertook cross-country comparisons of reproductive healthcare providers using DHS data, often without clear definitions (Table 2). Many use the public and private headings provided by the DHS.

However, DHS headings lack detail and are inconsistent between countries, particularly when it comes to the not-for-profit sector. Taking the example of family planning provider headings, 31 of the 57 countries studied use ‘public’, ‘private medical’ and ‘other’, while seven countries label their headings as ‘public’, ‘private’ and ‘other’, and do not distinguish the clinical/medical nature of the private sector. Ten countries distinguish between the ‘private sector’ and the ‘non-governmental’ or ‘community’ sector. The ‘other’ or ‘community’ headings can include a mix of public, private, or family/friend sources and of medical and non-medical sources, for example, schools and faith-based clinics. Countries that break down their headings further include Egypt, which groups responses into ‘Ministry of Health’, ‘other governmental’, ‘non-governmental’, ‘private medical’, ‘other private’ and ‘other non-medical’; Swaziland, which splits the private sector into ‘private’, ‘mission’ and ‘NGO’; and Zimbabwe, which splits the private sector into ‘mission’, ‘private medical sector’, ‘retail outlets’ and ‘other private’ sources. Perhaps as a result of these inconsistencies, many previous studies combine NGOs and faith-based organisations (FBOs) with the commercial private sector, which ignores potential variation in the aims and incentives of these providers [9].

The headings for persons providing care are less detailed than those for location; 43 of the 57 countries

K. Footman *et al.* **Who provides reproductive health services in LMICs: a critical appraisal of the DHS****Table 2** Studies comparing sources of family planning, delivery care and antenatal care in multiple low- and middle-income countries

Author, Year	Sector categories and definitions	Type of care
Bulatao <i>et al.</i> , 1993[22]	<i>Public</i> : not defined <i>Pharmacies and shops</i> : commercial outlets <i>Private practitioner</i> : private practitioners, clinics, and hospitals, including employer supported services <i>Voluntary</i> : non-governmental organisations (private voluntary organisations and various donor-funded agencies), private universities, and contractors	Family planning
Ayad <i>et al.</i> , 1994[23]	<i>Government stationary</i> : any government-run facility at a fixed location <i>Government mobile</i> : government outreach workers or mobile units <i>Pharmacy</i> : privately owned sources <i>Other private</i> : private organisations run by NGOs as well as private doctors, clinics or other medical providers <i>Other sources</i> : family, friends and inconsistent responses AND <i>Private for-profit</i> : private doctor, private hospital, private clinic, pharmacy, market, shop NGO: IPPF and church institutions <i>Public</i> : government, parastatal <i>Other</i> : friends, parents, other responses AND <i>Public</i> : government, parastatal <i>Private</i> : private doctor, private hospital or clinic, pharmacy, NGO <i>Church</i> : Protestant missions, Catholic churches <i>Other</i> : friends, parents, other	Family planning
World Bank, 1994[24]	<i>Public</i> : not defined <i>Private commercial</i> : not defined <i>Private voluntary</i> : not defined	Family planning
Berman and Rose, 1996[9]	<i>Public</i> : not defined <i>Private</i> : pharmacies, unless otherwise specified in the survey <i>Other</i> : includes traditional providers, schools, churches, family and friends and others Relies primarily on classification adopted by each country when they analysed data.	Family planning
Curtis and Neitzel, 1996[25]	<i>Government stationary</i> : government-run in fixed location <i>Government mobile</i> : government outreach workers, mobile units <i>Pharmacy</i> : privately owned pharmacy, drug store <i>Other private</i> : NGOs, private doctors, private clinics, other medical providers <i>Other sources</i> : family, friends, church, general shops, do not know	Family planning
Hanson <i>et al.</i> , 2001[26]	<i>Public</i> : not defined	Family planning
Centres for Disease Control and Prevention and ORC Macro, 2003[27]	<i>Public medical sector</i> : maternity hospitals, gynaecologic wards, women's consultation clinics, polyclinics, village hospitals and dispensaries <i>Private clinic/office</i> : private clinics, NGOs <i>Commercial sales</i> : pharmacies <i>Other</i> : partners, friends and relatives	Family planning
Taylor <i>et al.</i> , 2004[28]	<i>Ministry of Health</i> : not defined <i>Private</i> : not defined AND For those covered by social security <i>Ministry of Health</i> : clinic, hospital or programme <i>Social security institute</i> : system clinics, hospital or programme <i>Commercial pharmacy</i> <i>Other</i> : private sector clinic or hospital, NGO, community promoter, other	Family planning

K. Footman *et al.* **Who provides reproductive health services in LMICs: a critical appraisal of the DHS****Table 2** (Continued)

Author, Year	Sector categories and definitions	Type of care
Sharma <i>et al.</i> , 2005[29]	<i>Ministry of Health</i> <i>Social Security</i> <i>Private clinics/hospitals</i> <i>Commercial pharmacies</i> <i>NGOs</i> <i>Other</i>	Family planning
Zellner <i>et al.</i> , 2005[30]	<i>Private</i> : for-profit and not-for-profit, includes private practitioners, clinics, hospitals, laboratories, diagnostic facilities, NGOs, FBOs, shopkeepers, traditional healers, pharmacies, pharmaceutical wholesalers, distributors and manufacturers.	Family planning
Gwatkin <i>et al.</i> , 2007[31]	<i>Public facility</i> : government hospitals, health centres, health posts, dispensaries; facilities operated by government-affiliated social securing programmes. <i>Private facility</i> : private hospitals or clinics, private doctors' offices, facilities operated by other private medical providers (such as NGOs) as defined in the country concerned; private pharmacies or shops.	Family planning
Khan <i>et al.</i> , 2007[32]	<i>Public sector</i> <i>Private medical sector</i> <i>NGOs</i> <i>Other</i> : includes NGO for analysis of time trends Country-specific definitions of these sources are maintained to facilitate analysis.	Family planning
Stupp <i>et al.</i> , 2007[33]	<i>Ministry of Health</i> <i>Social Security</i> (does not exist as source in Nicaragua) <i>Family planning association</i> <i>Private</i> : private provider, private clinic, pharmacies <i>Other</i> Do not know	Family planning
Agha and Do, 2008[34]	<i>Public</i> : government hospitals/clinics; government health centres <i>Private</i> : private hospitals/clinics; private doctors, pharmacies; shops/stores <i>NGO/other</i> : NGOs; friends/relatives	Family planning
Limwattananon, 2008[35]	<i>Public</i> : government hospital/clinic; government field worker; family welfare centre <i>Formal private</i> : private hospital/clinic; doctor; pharmacy; NGO clinic, depot holder, fieldworker <i>Informal</i> : shop; church; friend/relative; other; unspecified	Family planning
Hotchkiss <i>et al.</i> , 2011[36]	<i>Government sector</i> : not defined <i>Private commercial sector</i> : commercial outlets including chemists, shops, pharmacies, traditional healer/doctor, midwife, and private healthcare facilities and workers <i>Other sources</i> : NGOs, faith-based organisations, relatives, friends and others	Family planning
Nguyen <i>et al.</i> , 2011[37]	<i>Public</i> <i>Private for-profit (facilities)</i> : hospital and clinics <i>Private for-profit (pharmacies)</i> : pharmacies, drug vendors and shops <i>Private not-for-profit</i> : not defined <i>Other</i>	Family planning

Table 2 (Continued)

Author, Year	Sector categories and definitions	Type of care
Chapman <i>et al.</i> , 2011[38]	<i>Public</i> : government hospital, government health centre, family planning clinic, mobile clinic, other public, rural health centre <i>Private</i> : private hospital, private doctor, other private, mission facility, other retail <i>Pharmacy</i> <i>Shop</i> : gas station or general shop <i>Friends or family</i> <i>Other</i> : bars, clubs, church	Family planning
Ross and Agwanda, 2012[39]	<i>Public</i> : not defined <i>Non-public</i> : includes private medical sector and pharmacies	Family planning
Wang <i>et al.</i> , 2012[40]	<i>Public</i> : public hospital, public health centre, public clinic/dispensary, other public <i>Private</i> : private hospital/clinics, private pharmacy, other private <i>Other sources</i> : shop, friends/church, other, missing	Family planning
Belizan <i>et al.</i> , 1999[41]	<i>Public and social security</i> : free of charge <i>Private</i> : charge fees directly or through insurance	Delivery care
Bell <i>et al.</i> , 2003[42]	<i>Government hospital</i> <i>Government health centre</i> <i>Private hospital/health centre</i> <i>Other health facility</i> <i>Domiciliary</i>	Delivery care
Brugha and Pritze-Aliassime, 2003[43]	<i>Public</i> <i>Private</i> : DHS categories – outside the direct control of the state, on a for-profit or non-profit basis <i>Home</i>	Delivery care
Gwatkin <i>et al.</i> , 2004[44]	<i>Public</i> : not defined <i>Private</i> : includes advanced facilities or providers, traditional healers, pharmacies, untrained village midwives, non-governmental not-for-profit	Delivery care
Jurdi and Khawaja, 2004[45]	<i>Public</i> : not defined <i>Private</i> : not defined	Delivery care
Peters <i>et al.</i> , 2004[46]	<i>Private</i> : not defined <i>Public</i> : not defined <i>Home</i> : not defined	Delivery care
Zellner <i>et al.</i> , 2005[30]	<i>Private</i> : for-profit and not-for-profit, includes private practitioners, clinics, hospitals, laboratories, diagnostic facilities, NGOs, FBOs, shopkeepers, traditional healers, pharmacies, pharmaceutical wholesalers, distributors and manufacturers	Delivery care
Gwatkin <i>et al.</i> , 2007[31]	<i>Public</i> : government hospitals, health centres, health posts, dispensaries; or facilities operated by government-affiliated social securing programmes <i>Private</i> : private hospitals or clinics, private doctors' offices, facilities operated by other private medical providers (such as NGOs). Excluded private pharmacies and shops. <i>Home</i> : woman's own or any other home	Delivery care
Houweling <i>et al.</i> , 2007[47]	<i>Public</i> : government hospital, government health centre, government maternity centre, other country-specific public sector facilities <i>Private</i> : mission hospital/clinic, other private hospital or clinic	Delivery care
Stupp <i>et al.</i> , 2007[33]	<i>Ministry of Health facility</i> <i>Social Security facility</i> (does not exist in Nicaragua) <i>Private facility</i> <i>Home with TBA</i> <i>Home alone</i> : nobody assisted <i>Home with others</i> : family, friends, medical personnel	Delivery care

K. Footman *et al.* **Who provides reproductive health services in LMICs: a critical appraisal of the DHS****Table 2** (Continued)

Author, Year	Sector categories and definitions	Type of care
Limwattananon, 2008[35]	<i>Public:</i> Government hospital, government health centre/post, government maternity home, community health centre, primary health centre, government dispensary, other public facility <i>Private:</i> Private hospital/clinic, private maternity home, non-governmental organisation hospital/clinic, mission hospital/clinic, other private facility <i>Informal private:</i> traditional birth attendant's home, midwife's home, relative's home, respondent's home, other	Delivery care
Yoong <i>et al.</i> , 2010[48]	<i>Public:</i> public health facilities <i>Medical private sector:</i> private, non-profit/NGO and mission/religious hospitals, clinics, health centres, dispensaries and pharmacies. <i>Excluded:</i> shops, traditional healers <i>Home</i>	Delivery care
Wang <i>et al.</i> , 2011[49]	<i>Public:</i> based on DHS categories <i>Private:</i> based on DHS categories <i>Home</i> <i>Other</i> Missing/Do not know	Delivery care
Montagu <i>et al.</i> , 2011[50]	<i>Public:</i> government hospital, government health centre, government health post, other public sector <i>Private:</i> private hospital/clinic and other private sector <i>Religious providers:</i> mentioned in results but not defined in methods <i>Home/Other person's home</i> <i>Excluded:</i> other responses	Delivery care
Limwattananon <i>et al.</i> , 2011[51]	<i>Public:</i> facilities under jurisdiction of national or local. Government hospital, government health centre/post, government maternity home, community health centre, primary health centre, government dispensary, other public facility <i>Private:</i> well-defined commercial, for-profit entities and non-governmental organisations, foundations or missions, other private facility. For-profit hospital/clinic, private for profit maternity home, non-governmental organisation not-for profit hospital/clinic, mission hospital/clinic, other private facility <i>Non-institutional:</i> traditional birth attendant's home, midwife's home, relative's home, pregnant woman's home, other non-facility <i>Faith-based organisations (FBOs):</i> not defined	Delivery care
Kagawa <i>et al.</i> , 2012[52]	<i>Public:</i> not defined	Delivery care
Tey and Lai, 2013[53]	<i>Private:</i> not defined <i>Non-institutional:</i> not defined	Delivery care
Pomeroy <i>et al.</i> , 2014[54]	<i>Government:</i> not defined <i>Private:</i> not defined <i>NGO:</i> not defined (excluded in multivariate analysis) <i>Home:</i> not defined	Delivery care

group response options only into 'health professional' or 'health personnel', and 'other person'. Slightly more detail is provided by four countries that distinguish between 'health professional', 'other personnel' and 'other person', although the distinction in skill level between 'health professional' and 'other personnel' is not clear. The DHS reports do not clarify the issue; the term 'skilled attendant' is not consistent with what is recognised internationally. For example, in the DHS report for

the Republic of Congo, an 'aide soignante/agent de sante communautaire' is grouped into 'trained personnel' alongside 'doctor', 'nurse' and 'midwife', whereas WHO does not consider these providers to be skilled attendants [10]. This in part reflects the complexity of defining skilled attendance; there can be variations between what countries consider as a skilled birth attendant, and the characterisation used by WHO, which creates challenges for DHS.

Our classification of sources of maternal and reproductive care

Taking into account these challenges, we developed a classification for our analysis of provider type that intended to group provider response options according to the two key dimensions identified earlier in the study: clinical nature and profit motive. The persons providing care were classified only according to their clinical skills. Information from the DHS country reports was combined with information from academic literature, grey literature and a WHO factsheet on skilled attendance [10] to place each country-specific response option in the correct group. The number of women using each provider type was also taken into account when grouping providers to avoid very small categories. The number of women was weighted to account for the survey design which over-sampled some geographic strata. When calculating estimates for the 57 countries overall, we also weighted by the country population using UN population estimates for 2005 [11].

To classify provider response options according to these dimensions, we used the original DHS headings to first group providers as public or private (Table 1). However, taking into account the heterogeneous nature of the private sector, we broke this group down further into NGO, FBO and private commercial. Some countries currently ask the costs paid for health care, and we considered using this woman-based information about formal and informal user fees to better capture the potential incentives of providers, but found high levels of missing data to be an issue [12]. The clinical nature of provider and person were classified differently for each type of care (family planning, and antenatal and delivery care) as follows, as each has different skill requirements.

Family planning

For family planning, only information on the provider was available. We initially classified each provider as medical/clinical or not. However, due to the diversity in the non-medical private sector, which ranged from vending machines and petrol stations to private pharmacies, we further divided the non-medical private sector into general commercial retailers (such as shops or bars) and specialised drug sellers, as these were likely to have very different clinical capacity. Merging groups that were too small or too difficult to distinguish between yielded eight groups: public medical, public non-medical, private retailer, private specialised drug seller, private medical, FBO, NGO and other (Table 1).

The application of our classification of family planning providers can be seen in Figure 1. The vertical axis of the graph describes the commercial nature (profit motive) of the provider, from the public to the not-for-profit to the private commercial sector, while the horizontal axis describes the clinical level of the provider, from a shop or relative to a hospital. Figure 1 also displays the number and variety of family planning providers, with each circle representing a unique response option. The size of each circle reflects the weighted number of women that reported using each provider type in 57 countries. The large number of very small circles demonstrates the high number of response options that are only selected by a few respondents, suggesting some potential for rationalisation.

The level of certainty with which we can classify each response option according to these two dimensions varies by provider. The public/private classification is aided by the existing DHS headings, though there are complexities in this distinction, as discussed above. The classification of providers' clinical capacity is even more uncertain, particularly as the same response option can mean different things in different contexts. For example, pharmacies are considered formal providers of healthcare, but in many LMICs, there are few trained professional pharmacists, and pharmacy employees with little education and no formal training sell medications without prescriptions or support from a trained professional [13]. In some countries, drug sellers, for example chemical sellers in Ghana, are not required to employ qualified pharmacists [14]. Services obtained from other sources, such as friends and relatives, cannot be classified by sector.

Antenatal and delivery care provider

All response options capturing delivery facilities were medical institutions. The clinical nature of the provider was therefore defined in terms of the level of the facility, resulting in seven groups which similarly combine information about the profit motive and clinical level of the provider: home, public facility, private facility, private professional, NGO, FBO, other private, and other. Again, groups that were too small or difficult to distinguish were merged. Due to category error described above, the private professional group does not tell us where the care took place, which is particularly problematic for delivery care as we cannot tell whether the location could manage complicated deliveries. Conflation of higher and lower level facilities also prevented us from separating public hospitals from lower level public facilities, due to response options such as hospital/clinic/institution/health post in Colombia. For births outside of facilities, such as

those in respondents' homes, we have information that enables us to classify whether the birth was with a skilled attendant, but they cannot be classified by sector.

An additional complication presented itself in the analysis of antenatal care providers. While a delivery can occur only in one location, women can receive antenatal care multiple times and from various sources during the pregnancy. Recognising this situation, the DHS questionnaires allow for (and actively elicit) multiple response options to be selected by respondents. The respondents are also asked about the total number of antenatal care visits they received during the pregnancy. However, for women with two or more provider response options selected, there is no information on the number of visits received from each provider type. This type of information would allow for a more detailed understanding of patterns of care received by women during pregnancy. However, because this level of data is not collected, we had to create four simple combinations of sectors from which women obtained antenatal care: only at home, public only (includes public in combination with home), private only (includes private in combination with home), or public and private (includes public/private in combination with home). We have applied this approach to describe quality of antenatal care across the various providers [15]. For antenatal care outside of facilities, such as those in the respondents' homes, we cannot classify the sector.

Person providing antenatal and delivery care

Respondents could list multiple persons providing delivery and antenatal care. When women reported multiple persons, we considered the most highly qualified option. On the DHS questionnaires, the persons providing antenatal or delivery care appear under the headings 'health personnel' or 'other persons'. To classify these individuals according to their skill level and ability to safely attend normal or complicated deliveries, we developed more detailed groupings: doctor; nurse/midwife; auxiliary midwifery staff; auxiliary staff; traditional birth attendant (TBA); community health worker (CHW); traditional practitioner; general facility staff; husband/friend; other; and no one. The first three groupings constitute skilled birth attendants. Conflation of response options also caused problems for these groupings; when nurse/midwives were conflated with less skilled providers such as lady health visitors, these response options were placed in the nurse/midwife group in our classification. This may mean that a skilled birth attendant did not in fact provide some of the care falling into this group. Response options meaning different things in dif-

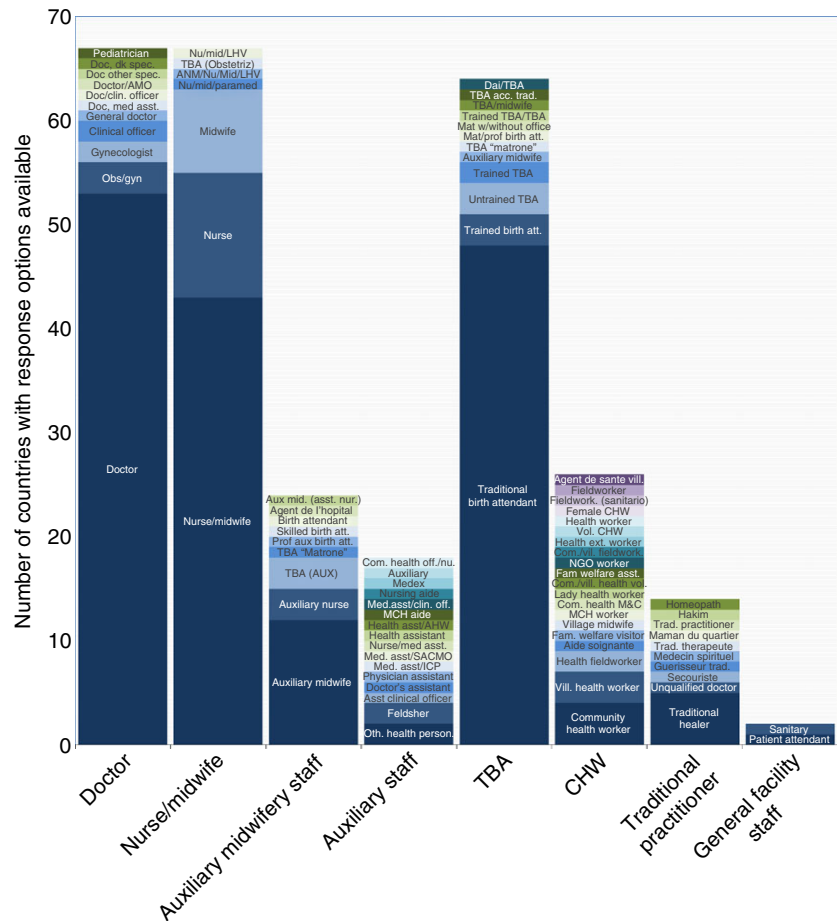
ferent countries was also an issue; the response options 'auxiliary midwife', 'trained birth attendant' and 'matron' are classified between different groups, depending on the skill level in the country of survey (Figure 2, bars showing auxiliary midwife, auxiliary staff and TBA groups).

Acknowledging complexities

A number of challenges existed for the development of our classification due to ambiguities in source of care data, such as conflation of response options, category error and categories for which public or private nature cannot be determined (e.g., home-based care). However, it is also important to consider the wider complexities that exist when distinguishing between provider types, as simple distinctions such as public/private or job title may not always be informative. As mentioned, the data relies on respondents' ability to recall and distinguish between different types of providers. However, even when the distinction between public and private providers is clear to respondents, there may be little difference between these sectors in terms of the providers' incentives and the quality of care they provide in some countries. For example, public providers financed by fee-for-service may have similar profit motives as private providers, particularly when user charges are informal or when the public sector is being marketised through increased competition and pay-for-performance systems. There is also considerable diversity in the quality of care provided within both the public and the private sector; for example, a study in rural India found that quality of care varied from excellent to dangerous among both public and private providers [16].

Additionally, even with perfect respondent recall, it is not always possible to know the medical/clinical level of a facility or individual from their name or title alone; hospitals that lack capacity in terms of drugs, equipment and staff may not be a safe place to conduct a delivery, while poor regulation and lack of revalidation means that health personnel may lack the skills that their titles imply [17]. Studies assessing and comparing competencies of skilled attendants in LMICs found that lack of standardisation in titles, training, knowledge and functions performed remains a challenge [18–20]. Even within countries, the term used to describe a set of persons providing care can be too broad for programmatic use, for *example traditional birth attendants* in Bangladesh encompass a wide range of individuals with different modes of working and varying levels of interest in working with or opposing formal health services [21].

Figure 2 Our classification of DHS delivery attendant response options, showing number of countries with each response option. Acc: accoucheuse; AHW: assistant health worker; AMO: assistant medical officer; ANM: auxiliary nurse/midwife; Asst: assistant; Att: attendant; Aux: auxiliary; CHW: community health worker; Clin: clinical; Com: community; DK: Do not know; Doc: doctor; Ext: extension; Fam: family; Fieldwork: fieldworker; LHV: lady health visitor; M&C: mother and child; Mat: matrone; MCH: maternal and child health; Med: medical; Mid: midwife; NGO: non-governmental organisation; Nu: nurse; Obs/gyn: obstetrician/gynecologist; Off: officer; Oth: other; Paramed: paramedic; Person: personnel; Prof: professional; SACMO: sub-assistant community medical officer; Spec: speciality; TBA: traditional birth attendant; Trad: traditional; Vil: village; Vol: volunteer.



Recommendations

DHS clarity

Many of the challenges for comparability of DHS data outlined in this study are difficult to avoid due to widely different organisational structures in health systems in DHS countries and legitimate country needs. In this study, we have outlined some of the challenges faced in comparing data across countries, but it is important to note that for many countries, source of care data is reasonably comparable.

However, the data collected on sources of care could be strengthened by clarification and rationalisation of response options. One of the main issues is conflation of response options, such as nurse/midwife, preventing accurate assessment of provider capacity. Whether response options were conflated because of infrequent responses or the inability of respondents to distinguish between providers, this should be elucidated to data users. However, grouping together providers or professionals that have

different skills or capacities should be avoided. The large number of response options is also an issue, and it seems that some response options could be rationalised by excluding response options that exist in very few countries or have zero or few users. While the importance of response options may change over time, it should be possible to capture such changes within the ‘Other, Specify...’ response option. Additional limitations that could also be addressed by DHS include removing health attendants from response options in the question that asks for the location where respondents received care. Where care is obtained at home, it may be worth asking if the provider was a public or a private sector worker.

Lastly, we raised several issues related to analysis of DHS data sets which impede or prevent correct cross-country comparisons. Further standardisation of variable names, response codes and locations of variables in the data set would greatly enhance this task. An effort to harmonise DHS variables through the Integrated Demographic and Health Series (IDHS) database is being

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developed at the Minnesota Population Center at present. As of August 2014, it had compiled a selection of maternal health variables from 39 surveys in nine countries. Clearly, the need for better integration of DHS data has been identified, and greater progress can be made in this area.

Metadata

DHS surveys are designed to meet specific host-country needs, and it is important that countries have the freedom to define their own response options, to meet the needs of in-country implementation programmes and match local contexts. However, to facilitate comparative studies, the DHS could develop metadata that describe the characteristics of providers in each country. This would be particularly useful for understanding who is considered a skilled birth attendant, as this is a complex matter. These specificities are difficult and labour-intensive to assess when conducting cross-country comparisons, and without country-specific input, are likely to be inaccurate. Before releasing the data, country teams could be asked to place each of their response options into a pre-defined classification that captures important provider characteristics. There is no standardised global classification for describing health-care providers, but the starting point we have created could be further developed for metadata through a consultative process to ensure it meets the needs of researchers, programme implementers and other stakeholders. Countries could also be asked to provide additional information to facilitate analysis, such as whether each health attendant response option is certified as a skilled birth attendant according to national and international standards, and their expected skills, capacities, training, accreditation and regulation requirements. This type of information would be extremely useful in determining the relative skill level of health attendants, thereby reducing the complexities of analysing source of care data across countries.

DHS could also use metadata to clarify whether a country had large public sector initiatives to provide home-based antenatal or delivery care, to better understand the sectors involved in home-based provision. DHS has spent a great deal of effort harmonising survey questions with the Multiple Indicator Cluster Surveys across countries. Although comparison of DHS source of care data with other international surveys was beyond the scope of this study, there are likely similar comparability issues with such surveys. Metadata could therefore be useful for international surveys beyond the DHS and could also map on to the DHS

Service Provision Assessment facility questionnaire for comparability.

Conclusion

Cross-country comparisons of the sources of reproductive and maternal care are important for evaluating progress towards universal coverage of high-quality services. At present, such cross-country comparisons are difficult to conduct using DHS data due to differences in response options, headings and coding and analysis of data sets. Some clarification and rationalisation of these response options could aid analysis and processing of data. Variations in the meaning and capacities of different types of providers and health personnel across countries also create analytical challenges, as does missing information on the sector of provision. To address this, metadata would allow country teams to group providers and professionals accurately, and provide important details about, for example, their skill level, training, accreditation and role in the health system.

The terminologies used in the literature to categorise health providers has been inconsistent and inadequately detailed, potentially in part due to limitations of the data on which they are based. The classification we developed in this paper addressed some of the shortcomings of previously used classifications that often differentiate providers only into public or private. Our classification combines information about the public or private nature of providers, taking into account the heterogeneous nature of the private sector, and the medical level of providers. These two dimensions capture important issues for the provision of care, such as accessibility, quality and patient costs. As priorities in global health shift towards universal health coverage, more systematic collection of data on type of provider, content/quality of care and user fees would aid international comparisons of progress towards improved coverage, equity and financial protection, as well as allowing us to better characterise the incentives and commercial nature of different providers.

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Appendix I.Countries and surveys used

Region	Country	Survey Year	Sample of women	Family planning and delivery care	Antenatal care
Sub-Saharan Africa	Benin	2006	All	Yes	No
	Burkina Faso	2010	All	Yes	Yes
	Burundi	2010	All	Yes	Yes
	Cameroon	2011	All	Yes	Yes
	Chad	2004	All	Yes	No
	Republic of the Congo	2005	All	Yes	No
	Democratic Republic of Congo	2007	All	Yes	No
	Ethiopia	2011	All	Yes	Yes
	Gabon	2012	All	Yes	Yes
	Ghana	2008	All	Yes	Yes
	Guinea	2005	All	Yes	No
	Kenya	2008–9	All	Yes	Yes
	Lesotho	2009	All	Yes	Yes
	Liberia	2007	All	Yes	Yes
	Madagascar	2008–9	All	Yes	Yes
	Malawi	2010	All	Yes	Yes
	Mali	2006	All	Yes	No
	Mozambique	2011	All	Yes	Yes
	Namibia	2006–7	All	Yes	Yes
	Niger	2006	All	Yes	No
	Nigeria	2008	All	Yes	Yes
	Rwanda	2010	All	Yes	Yes
	Sao Tome and Principe	2008–9	All	Yes	Yes
	Senegal	2010–11	All	Yes	Yes
	Sierra Leone	2008	All	Yes	Yes
	Swaziland	2006–7	All	Yes	Yes
	Tanzania	2010	All	Yes	Yes
	Uganda	2011	All	Yes	Yes
	Zambia	2007	All	Yes	Yes
	Zimbabwe	2010–11	All	Yes	Yes
	Number of countries analysed in region			30	23
North Africa/ West Asia/Europe	Albania	2008–9	All	Yes	Yes
	Armenia	2010	All	Yes	Yes
	Azerbaijan	2006	All	Yes	Yes
	Egypt	2008	Ever-married	Yes	Yes
	Jordan	2007	Ever-married	Yes	Yes
	Moldova	2005	All	Yes	Yes
	Morocco	2003–4	All	Yes	No
	Turkey	2003	Ever-married	Yes	Yes
	Ukraine	2007	All	Yes	Yes
		Number of countries analysed in region			9
South/Southeast Asia	Bangladesh	2011	Ever-married	Yes	Yes
	Cambodia	2010	All	Yes	Yes
	India	2005–6	Ever-married	Yes	Yes
	Indonesia	2007	Ever-married	Yes	Yes
	Maldives	2009	Ever-married	Yes	Yes
	Nepal	2011	All	Yes	Yes
	Pakistan	2006–7	Ever-married	Yes	Yes
	Philippines	2008	All	Yes	Yes
	Timor-Leste	2009–10	All	Yes	Yes
	Vietnam	2002	All	Yes	No
	Number of countries analysed in region			10	9

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Region	Country	Survey Year	Sample of women	Family planning and delivery care	Antenatal care	
Latin American and the Caribbean	Bolivia	2008	All	Yes	Yes	
	Colombia	2010	All	Yes	Yes	
	Dominican Republic	2007	All	Yes	Yes	
	Guyana	2009	All	Yes	Yes	
	Haiti	2012	All	Yes	Yes	
	Honduras	2011–12	All	Yes	Yes	
	Nicaragua	2001	All	Yes	No	
	Peru	2000	All	Yes	Yes	
	Number of countries analysed in region				8	7
	Total number of countries analysed				57	47

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