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COMPARISON OF TWO METHODS FOR DETERMINING PROVIDER ATTENDANCE DURING NORMAL LABOR AND DELIVERY

RESULTS FROM BENIN, ECUADOR, JAMAICA, AND RWANDA

QUALITY ASSURANCE PROJECT

OPERATIONS RESEARCH RESULTS

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Bart Burkhalter and Larissa Jennings

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ABSTRACT

The Quality Assurance Project (QAP) compared two data collection methods used to determine the number and type of providers who attended 245 obstetric cases in hospitals in Benin, Ecuador, Jamaica, and Rwanda. Each case was viewed as having four phases (labor, intrapartum, postpartum-mother, and postpartum-newborn) resulting in 980 possible phases, referred to as "phase-cases."

In all, 801 phase-cases were observed and assessed using both data collection methods. In the first method, an observer recorded the names or identification number of all providers attending the case in a table on the first page of a pre-printed data collection form (the "Page 1 method"). In the second method, the same observer recorded the identity of the provider next to each required task on the form as the provider performed the task (the "Task-by-task method"). The form is appended to Burkhalter et al. (2006).

This report discusses the number of providers recorded by each method and addresses the problem generated by the fact that the two methods resulted in identical lists of providers in only 46% of the 245 obstetric cases. To address this problem, we present an analysis that generates a best ("Combined") method from the two original methods (Page 1 and Task-by-task). The average number of providers recorded was 3.65 by the Task-by-task method, 3.44 recorded by the Page 1 method, and 4.02 when the data from both methods were combined. An estimated 2% of providers were not recorded by either method.

Over all countries, the Task-by-task method missed fewer providers than the Page 1 method in the intrapartum (12% compared to 51%), postpartum-mother (27% compared to 38%), and postpartum-newborn phases (14% compared to 40%), but missed more providers in the labor phase (36%) than the Page 1 method (22%). Based on the Combined data, the labor phase had the highest average number of attending providers at 2.8; intrapartum had 1.8 attending providers, postpartum mother had 1.7, and postpartum-newborn had 1.6. The labor phase was also most likely to be attended by at least one skilled provider (doctor, nurse, or midwife): 96% of the time. This rate for intrapartum was 90%, for postpartum-mother 84%, and postpartum-newborn 79%. Among all attending teams and phases, 88% included at least one skilled provider. Skilled provider attendance varied by country, ranging from 73% to 99%.

Our analysis shows that the Combined method was superior to the Page 1 method in 37% of the phase-cases and superior to the Task-by-task method in 23% of the phase-cases. The superiority of the Combined method varied by country, ranging from 25% of phase-cases in Rwanda to 57% in Benin when compared to the Page 1 method. Compared to the Task-by-task method, the superiority of the Combined method ranged from 14% of phase-cases in Rwanda and Ecuador to 35% of phase-cases in Jamaica. These findings suggest that using the Page 1 or Task-by-task method separately will require substantial improvements in these data collection processes. In settings where data collection methods are poor, the Combined method was superior in determining the number and type of all attending providers.

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1. INTRODUCTION

Funded by the U.S. Agency for International Development (USAID), the Quality Assurance Project (QAP) supports efforts to institutionalize quality assessment methods in developing country health systems. Such efforts need to identify the best methods for assessing quality of care in diverse settings (Hermida, Nicholas, and Blumenfeld 1999). In response, this paper describes the results of a comparison of two data collection methods used to determine the number and type of providers attending normal labor and delivery in 14 hospitals in Benin, Ecuador, Jamaica, and Rwanda. It also proposes a third, superior method that builds on the first two.

Various aspects of the attending team may influence the quality of care, such as the number of providers, their competence and motivation, their organization into functioning teams, and supervision and leadership. This study is part of a larger investigation of the quality of obstetric care in developing countries and the factors that influence it (Burkhalter et al. 2006).

II. METHODS

A. OVERALL RESEARCH STRATEGY

Trained observers were asked to use two different methods to record the names (or ID [identification] numbers) of providers attending each observed obstetric case. For many cases, the two methods did not generate identical lists of providers, indicating errors in the observers' records. By assuming that all errors were errors of omission (a provider was in attendance but not recorded) and that none were errors of commission (a provider is recorded but did not attend), we could estimate the average number of providers captured by each method. By definition, combining the lists yields an at-least-as-good or better list than either method alone. We were also able to disaggregate the resultant data by country and phase of labor/delivery, generating more accurate estimates of how many providers attended each phase of each case (referred to as a "phase-case") than either original method would permit.

B. STUDY SITES

Countries were selected where QAP had a field office and to represent Africa, the Caribbean, and Latin America. QAP purposively selected study hospitals according to the following criteria:

1. A range of levels of care (See Table 1):
   - At least one large urban referral (tertiary care) hospital with an active maternity department that manages a large number of maternal complications;
   - One or two mid-sized (secondary care, regional) hospitals, and/or
   - One smaller district hospital.
2. An average of at least two births per day, sufficient to permit observation of at least five cases over a two- to three-day period;
3. One or more facilities located outside the capital city but geographically close enough to be manageable within the time and budget available; and
4. Facilities where QAP was conducting program activities, if possible.

In advance of data collection, the in-country study coordinator visited all study sites and briefed the facility director on the study and gained permission to conduct it in that facility. The

Abbreviations

ID	Identification
PROSAF	Benin Integrated Family Health Program
PP	Postpartum
QAP	Quality Assurance Project
URC	University Research Co., LLC
USAID	United States Agency for International Development
WHO	World Health Organization

coordinator also contacted the maternity department to coordinate patient flow observations. Based on the criteria proposed by Maine et al. (1997), all study hospitals qualified as Comprehensive Essential Obstetric Care facilities.

Table 1. Number of Sites by Type and Country

Country Name	Referral Hospitals	Regional or District Hospitals	Total
Benin	2	2	4
Ecuador	1	2	3
Jamaica	2	2	4
Rwanda	1	2	3
Total	6	8	14

C. DATA COLLECTION PROCEDURES

Using a structured checklist based on international standards for obstetric care (WHO 2000), the management of labor and delivery was observed in 245 hospital-based obstetric cases in the four countries. The observation period began when the woman arrived at the hospital and ended approximately two hours after the baby was born or when the woman left the hospital, whichever came first. The observation period covered four phases: labor, intrapartum, postpartum (PP) mother, and PP newborn, each of which is defined below:

Labor phase: For purposes of the study, the labor phase started when the woman arrived at the hospital and lasted until dilation was approximately 10 cm. Some women were already in labor when they arrived; others were not yet in labor when they arrived but began labor thereafter; and some went home without entering labor. In many cases the labor phase ended when the woman moved from the labor area to the delivery room.

Intrapartum phase: In this study, the intrapartum phase began when the labor phase ended (dilation about 10 cm) and ended when the placenta delivered.

Mother immediate postpartum phase (PP-mother): This phase included the two hours immediately following the delivery of the placenta. However, the observation time was often either longer or shorter than two hours (especially when the mother left the observation area early).

Newborn immediate postpartum phase (PP-newborn): This phase spans the same period as PP-mother but consists of monitoring and care of the newborn only.

Study personnel trained the data collectors during one-day sessions in each study country. Topics covered the rationale for the study, how it fit into the QAP country program, the Ministry of Health objectives (if applicable), and how the findings would be used to improve the quality of care. The data collection teams included obstetricians, gynecologists, pediatricians, midwives, and nurses. All data collectors were either retired or practicing in a facility other than those where they collected data. Observers were told that if during their observations they were concerned about the care or well-being of the mother or newborn, they should cease observing and intervene as they would normally do in practice.

In Rwanda and Jamaica, observers spent three consecutive 24-hour days, including a weekend day, at each facility. In Benin and Ecuador, observers spent non-consecutive 12-hour shifts, including days, evenings, nights, and at least one weekend day and night in each facility. Larger teams were generally used for large referral hospitals and smaller ones for smaller district hospitals. They collected data from February to July 2002: in Ecuador in February, in Rwanda and Benin in March, and in Jamaica in June and July.

D. ONE FORM, TWO DATA COLLECTION METHODS

This study's primary data source (Form 2.4, "Performance in Managing the 3 Stages of Normal Labor & Delivery," reprinted in Burkhalter et al. [2006]) was designed for the larger study. It was piloted in December 2001 in Spanish (for use in Ecuador) and later translated into English and French for administration in Rwanda, Jamaica, and Benin. It provided two methods to record data about the providers who attended each case, and observers were told to use both methods for every case.

The observer recorded attendance data for the Page 1 method in a table on the first page of the form (see Figure 1). For this method, the observer was to record in that table all the attending providers for that case, including his/her name or ID number, classification (i.e., doctor, midwife, nurse, etc.), and phases attended (i.e., labor, intrapartum, PP-mother, PP-newborn). Trainers instructed observers to record the name/ID of an attending provider in the Page 1 table as soon as he/she appeared, but in practice many observers recorded this information at the conclusion of the phase or observation period.

Figure 1. Excerpt from Page 1 of Data Collection Form

List of participating providers

11. Providers participating in this birth

Instructions: During the course of any labor and delivery, a series of different health providers may attend the patient. Please enter below the ID number of each provider participating in this case, indicating with an "X" the stage or stages in which he / she participates. At the same time, enter the provider's ID number on the register of providers kept separately.

No.	Provider ID Number*	*Stage of birth*				
		Labor	Expulsive Phase	Postpartum (Mother)	Postpartum (Neonate)	Provider Type
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8.						

**** Also enter this number in the provider register, kept separately***

Provider type:
1 = Attending physician
2 = Medical resident
3 = Midwife
4 = Nurse
5 = Intern
6 = Auxiliary nurse / Aide
7 = Other (describe)

Pages 2–8 of the form allowed observers to record attendance by task (e.g., suction the newborn), and researchers used those data for the Task-by-task method. These pages listed all the required tasks, and next to each was a space for recording the identity of the provider who performed the task. It was expected that the observer would record the performance of the task and the identity of the provider doing it as each task was performed.

For the present study, we collated the task-by-task data into a summary Task-by-task table. At the conclusion of this exercise, we had a Page 1 table and Task-by-task table, each with the name/ID, classification, and attended phases of individuals who provided care during each phase-case.

E. DETERMINING THE "BEST" DATA SOURCE

Ideally, the Page 1 table and the Task-by-task table would be identical for every case. However, sometimes the Page 1 table had names not in the other and vice versa. We generated four mutually exclusive categories to describe the resulting data set:

1. Both tables are identical ("Same");
2. The providers in the Task-by-task table are a subset of those in the Page 1 table ("Page 1 better");
3. The providers in the Page 1 table are a subset of those in the Task-by-task table ("Task-by-task better"); and
4. One or more providers in each table are in the other table, and each table has providers not on the other ("None is better").

We defined the "best" data source for a particular phase-case as the applicable category among these four. For example, when all the names listed for a phase-case were identical in both tables, the applicable category and therefore the best data source for that phase-case is "Same." When the Page 1 table included all names in the Task-by-task table plus some names not on the second table, the best data source is "Page 1 better." When the Page 1 table and the Task-by-task each had at least one provider not listed on the other table, we classified it as "None is better." Table 2 illustrates our classification system. It depicts four possible scenarios for three attending providers and shows the correct category for each.

Table 2: Determination of Best Data Source based on Providers Listed

Collection Method	Page 1	Task-by-task	Best Data Source	Combined Table
Listed providers	A, B, C	A, B, C	Same	A, B, C
	A, B, C	A, C	"Page 1" better	A, B, C
	B, C	A, B, C	"Task-by-Task" better	A, B, C
	A, B	B, C	"None is better"	A, B, C

Since neither the Page 1 nor the Task-by-task method always yielded data on all providers, a revised estimate of the providers attending each phase-case was called for. The revised estimate includes all providers identified in the Page 1 table plus all in the Task-by-task table for any phase-case (called the "Combined table"). We consider the Combined table to reflect the most accurate measure of providers attending each phase-case for two reasons:

- The Combined table always includes all the providers identified by either method, and
- We assume that these data are subject to errors of omission and not to errors of commission. (That is, all listed providers were present, but some providers who were present were not recorded by one method.) To the extent this assumption is false, we underestimate the number of attending providers.

We refer to the process of combining the Page 1 and Task-by-task data results as the "Combined method." in which both the Page 1 and Task-by-task methods are applied. Also, we distinguish between phase-cases where the two original methods yielded identical names ("same") and all other cases where they were not identical ("differential"). Differential cases include cases from the "Page 1 better," "Task-by-task better," and "None is better" categories. The total of any sample equals the sum of the "same" and "differential" phase-cases.

F. POOLED DATASET

The term "pooled dataset" refers to the aggregate data from four country samples. Results under the pooled sections are summations of the previous country data and serve as a benchmark for reviewing generally the results discussed in this study.

III. RESULTS

A. NUMBER OF OBSERVED CASES

In observing 245 normal obstetric cases, we had the potential of observing 980 (245 x 4) phases of labor and delivery, but not every case generated observations of four phases. Most instances of an unobserved phase resulted from women who were observed during labor but did not deliver during or before the observation period. Overall, 801 phases (82%) were observed, with labor the most frequently observed (95%). In order to be able to discuss (obstetric) cases, phases of labor and delivery, and phases within cases, we devised the term "phase-case" to refer to the last. For example, the intrapartum phase of case #72 is referred to as a phase-case. Table 3 shows the number and percentage of phase-cases observed by phase and country.

Table 3. Phase-Cases by Phase and Country

	Percentage of Phase-Cases Observed (Number Observed/Number of Phases)				
Phase-Case	Benin	Ecuador	Jamaica	Rwanda	Pooled Total
Labor	100 (41/41)	87.8 (36/41)	95.1 (98/103)	95.0 (57/60)	94.7 (232/245)
Intrapartum	90.2 (37/41)	100 (41/41)	61.2 (63/103)	81.7 (49/60)	77.6 (190/245)
PP-mother	90.2 (37/41)	100 (41/41)	62.1 (64/103)	76.7 (46/60)	76.7 (188/245)
PP-newborn	90.2 (37/41)	100 (41/41)	56.3 (58/103)	91.7 (55/60)	78.0 (191/245)
All phases	92.7 (152/164)	97.0 (159/164)	68.7 (283/412)	86.3 (207/240)	81.7 (801/980)

Jamaica and Rwanda presented 67% of all observed cases (42% and 24%, respectively), while Benin and Ecuador presented the remaining 33%. However, because Benin (93%) and Ecuador (97%) have a higher percentage of observed phase-cases (Table 3), they account for 39%, rather than 33%, of the phase-cases.

B. DIFFERENCES BETWEEN THE TWO METHODS

Proportion of differential phases: Table 4 presents the percentage of differential phase-cases by phase for each country and the pooled dataset. The Page 1 and Task-by-task tables differ in over half (54%) the observed phases: They agree only 46% of the time. The magnitude of differences varies by country: The two tables differed in 69% of Benin's cases, 59% of Jamaica's, 55% of Ecuador's, and 36% of Rwanda's.

Table 4. Percentage of Differential Phase-Cases by Phase and Country

	Percentage of Differential Phase-Cases (Number Differential/Number of Phase-Cases)				
Phase	Benin	Ecuador	Jamaica	Rwanda	Pooled Total
Labor	56.1 (23/41)	41.7 (15/36)	61.2 (60/98)	42.1 (24/57)	52.6 (122/232)
Intrapartum	89.2 (33/37)	75.6 (31/41)	58.7 (37/63)	26.5 (13/49)	60.0 (114/190)
PP-mother	59.5 (22/37)	70.7 (29/41)	57.8 (37/64)	39.1 (18/46)	56.4 (106/188)
PP-newborn	73.0 (27/37)	29.3 (12/41)	58.6 (34/58)	34.5 (19/55)	48.2 (92/191)
All phases	69.1 (105/152)	54.7 (87/159)	59.4 (168/283)	35.7 (74/207)	54.2 (434/801)

Although not as large as the differential between countries, there are variations by phase as well, ranging from 48% for the PP-newborn phase to 60% for the intrapartum phase. However, these patterns do not hold across countries. While Benin and Ecuador have the highest proportion of differential phase-cases for the intrapartum phase (89% and 76%, respectively), Jamaica and Benin have the highest proportion for labor phases (61% and 56%, respectively). In Ecuador, only 29% of PP-newborn cases had differential phase-cases compared to 73% in Benin.

The failure of any clear pattern to emerge among these differential phase-cases indicates that the causes of omission errors are multiple, varying across countries. This led us to investigate other data collection methods (specifically the Combined method) rather than to make closer observations to identify and correct errors in the current methods.

Average number of attending providers per case: Table 5 provides details by country of the average number of attending providers listed in the Page 1 and Task-by-task tables. Note, however, that the Page 1 table asked observers to record which phases were attended by each provider listed. On a few occasions, observers completed the Page 1 table but did not record which phase(s) each provider attended. Consequently, we provide two columns for that table: The first column shows the average number of providers where the observer recorded which phase(s) was attended, and the second shows the average number of providers whether their attendance by phase was recorded or not.

When we pool the samples, the average number of providers recorded in the Page 1 table is 3.65 (with phase also recorded) and 3.44 in the Task-by-task table. The larger average is mostly due to Jamaica's heavy weight in the pooled total: Without Jamaica, the average number of providers recorded in the Page 1 table is 3.58, compared to 3.53 in the Task-by-task table. In Rwanda and Benin, both methods yielded about the same number of recorded providers. When the providers recorded in either table are combined to produce a best estimate (Table 5's "Combined" column), the average number of attending providers increases by approximately 0.5% in Jamaica, 4.1% in Benin, and 7.6% in Rwanda as compared to the largest estimate of either the Page 1 or Task-by-task method. In Ecuador, there was no difference in the number of providers in the Combined table and Page 1 table.

Table 5. Average Number of Providers per Case by Method: All Countries

Country (n = Total Cases)	Providers Listed by Phase Attended **Page 1**	Providers Listed by Name or ID Only **Page 1**	**Task-by-Task**	**Combined**
Benin (n = 41)	3.93	4.12	3.95	4.29
Ecuador (n = 41)	4.34	4.37	4.02	4.37
Jamaica (n =103)	3.74	4.28	3.31	4.30
Rwanda (n = 60)	2.83	2.88	2.90	3.12
Pooled total (n = 245)	3.65	3.93	3.44	4.02

The average number of providers in either table (the combined dataset) includes all providers listed anywhere on the form. This includes providers listed by attending phase on the Page 1 table; providers listed on the Page 1 table without reference to phase attended; and providers listed in the Task-by-task table, which by design included information on phase attended.

C. IDENTIFYING THE BEST DATA COLLECTION METHOD

Table 6 gives the frequencies of the four categories of best data source (defined in Section II. E) by phase and country. Across all phases and countries, "Same" is the most frequent (46% of the cases), "Task-by-task better" is the second most frequent (31%); "Page 1 better" is third most frequent (17%); and "Combined better" is the least frequent (6%). For labor, the Page 1 table is substantially better at 31% than the Task-by-task table at 17%, but for the other phases, the Page 1 table is considerably worse: intrapartum (48% versus 9%), PP-mother (29% versus 18%), and PP-newborn phases (34% versus 8%).

Table 6. Percentage of Cases in Better Data Categories by Phase and Country

Phase	Better Data Categories	Country Percentage (x/y)				Pooled Total (n = 980)
		Benin (n = 164)	Ecuador (n = 164)	Jamaica (n = 412)	Rwanda (n = 240)	
Valid cases		152 (93%)	159 (97%)	283 (69%)	207 (86%)	801 (82%)
Labor	Same	44% (18/41)	58% (21/36)	39% (38/98)	58% (33/57)	47%(110/232)(
	Page 1 better	12% (5/41)	28% (10/36)	49% (48/98)	16% (9/57)	31%(72/232)
	Task-by-task better	32% (13/41)	11% (4/36)	10% (10/98)	21% (12/57)	17%(39/232)
	Combined better	12% (5/41)	3% (1/36)	2% (2/98)	5% (3/57)	5%(11/232)
Intrapartum	Same	11% (4/37)	24% (10/41)	41% (26/63)	73% (36/49)	40%(76/190)
	Page 1 better	3% (1/37)	0% (0/41)	21% (13/63)	6% (3/49)	9%(17/190)
	Task-by-task better	81% (30/37)	76% (31/41)	35% (22/63)	18% (9/49)	48%(92/190)
	Combined better	5% (2/37)	0% (0/41)	3% (2/63)	2% (1/49)	3%(5/190)
PP-mother	Same	41% (15/37)	29% (12/41)	42% (27/64)	61% (28/46)	44%(82/188)
	Page 1 better	22% (8/37)	20% (8/41)	19% (12/64)	13% (6/46)	18%(34/188)
	Task-by-task better	24% (9/37)	44% (18/41)	28% (18/64)	22% (10/46)	29%(55/188)
	Combined better	14% (5/37)	7% (3/41)	11% (7/64)	4% (2/46)	9%(17/188)
PP-newborn	Same	27% (10/37)	71% (29/41)	41% (24/58)	65% (36/55)	52%(99/191)
	Page 1 better	11% (4/37)	0% (0/41)	14% (8/58)	7% (4/55)	8%(16/191)
	Task-by-task better	59% (22/37)	27% (11/41)	33% (19/58)	24% (13/55)	34%(65/191)
	Combined better	3% (1/37)	2% (1/41)	12% (7/58)	4% (2/55)	6%(11/191)
All phases	Same	31% (47/152)	45% (72/159)	41% (115/283)	64%(133/207)	46%(367/801)
	Page 1 better	12% (18/152)	11% (18/159)	29% (81/283)	11% (22/207)	17%(139/801)
	Task-by-task better	49% (74/152)	40% (64/159)	24% (69/283)	21% (44/207)	31%(251/801)
	Combined better	9% (13/152)	3% (5/159)	6% (18/283)	4% (8/207)	6%(44/801)

Note. Better data categories are: "Same" when the Page 1 and Task-by-task tables list the same providers for a phase, "Page 1 better" when the Page 1 table contains all the providers in the Task-by-task table and more, "Task-by-task better" when this table contains all the providers in the Page 1 table and more, and "Combined better" when the Page 1 table contains some providers not in the Task-by-task table and vice versa.

Based on the assumption that the total number of providers not identified by the Combined method is zero (i.e., that the Combined method identifies *all* providers), Table 7 presents our computation of how far short each of our two original methods falls below 100%. The Page 1 table equals the Combined table for phase-cases in the "Same" or "Page 1 better" categories, and the Task-by-task table equals the Combined table for phase-cases in the "Same" or "Task-by-task better" categories. We found distinct differences in the performances of our two methods as compared to the Combined method. For example, for the labor phase in Benin, the Page 1 table lists the same names as the Combined table for 56% of the phase-cases (23 of 41), whereas the Task-by-task table is the same as the Combined table for 76% of the phase-cases. In this example, the Page 1 table misses attending providers 44% of the time, and the Task-by-task table misses attending providers 24% of the time. This suggests that the Combined table is better than either of the other methods for the Benin labor phase.

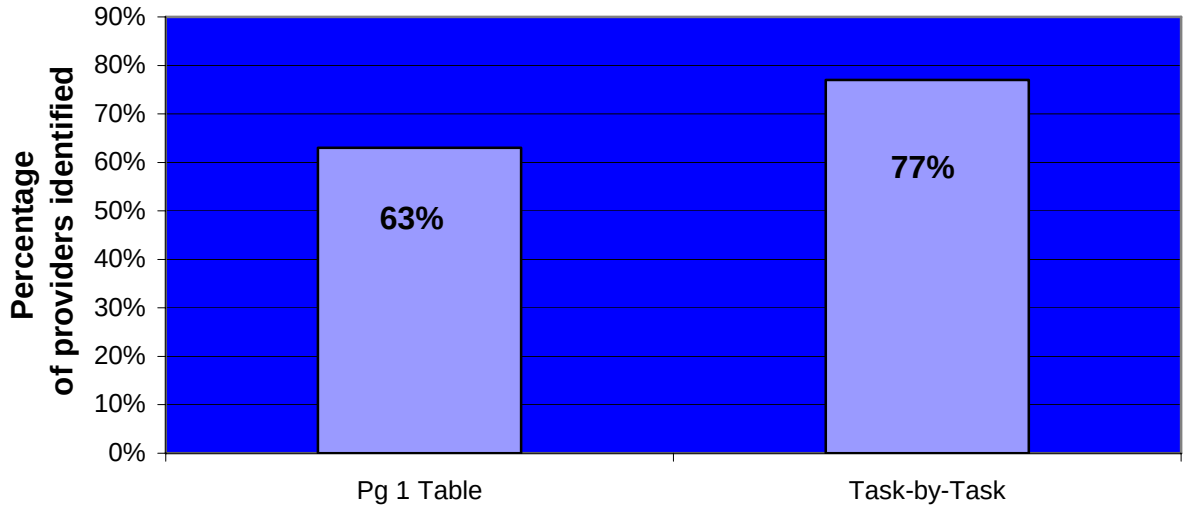
Table 7. Performance of Page 1 and Task-by-Task Methods Relative to the Combined Method by Phase and Country

Phase	Data Collection Method	Country Percentage (x/y)				Pooled Total (n = 980)
		Benin (n = 164)	Ecuador (n = 164)	Jamaica (n = 412)	Rwanda (n = 240)	
Valid cases		152	159	283	207	801
Labor	Page 1 table	56% (23/41)	86% (31/36)	88% (86/98)	74% (42/57)	78% (182/232)
	Task-by-task table	76% (31/41)	69% (25/36)	49% (48/98)	79% (45/57)	64% (149/232)
Intrapartum	Page 1 table	14% (5/37)	24% (10/41)	62% (39/63)	80% (39/49)	49% (93/190)
	Task-by-task table	92% (34/37)	100% (41/41)	76% (48/63)	82% (45/49)	88% (168/190)
PP-mother	Page 1 table	62% (23/37)	49% (20/41)	61% (39/64)	74% (34/46)	62% (116/188)
	Task-by-task table	65% (24/37)	73% (30/41)	70% (45/64)	83% (38/46)	73% (137/188)
PP-newborn	Page 1 table	38% (14/37)	71% (29/41)	55% (32/58)	73% (40/55)	60% (115/191)
	Task-by-task table	86% (32/37)	98% (40/41)	74% (43/58)	89% (49/55)	86% (164/191)
All Phases	Page 1 table	43% (65/152)	57% (90/159)	69% (196/283)	75% (155/207)	63% (506/801)
	Task-by-task table	80% (121/152)	86% (136/159)	65% (184/283)	86% (177/207)	77% (618/801)

Note. This table uses the Combined table as the "gold standard" with no errors of commission and all attending providers listed on at least one of the two other tables. The "Page 1" rows contain the percentage of cases where the Page 1 table equals the Combined table ("Same" + "Page 1 better" categories), and the "Task-by-task" rows contain the percentage of cases where the Task-by-task table equals the Combined table ("Same" + "Task-by-task better" categories).

As Figure 2 shows, over all countries and phases, the Task-by-task method performs better than Page 1 (77% versus 63%), but both miss many of the attending providers. Missing names occurred for each country and phase except for the Task-by-task method in Ecuador for the intrapartum phase.

Figure 2. Performance of Two Data Collection Methods as Percentage of Combined Method Pooled over All Countries and Phases



D. PROVIDER TEAM SIZE

We used data from the Combined table and found that the average number of attending providers across all phases and countries is 2.02. Of all the phases, labor has by far the largest number of providers in the

Combined data set and in each country (Table 8). The average number of providers attending labor ranged from 3.2 in Jamaica to 2.4 in Benin and Ecuador. On average, 2.8 providers attended during labor compared to 1.8, 1.7, and 1.6 during the intrapartum, PP-mother, and PP-newborn phases, respectively. For any phase, the average number of providers ranged from 1.6 to 2.8.

Table 8. Average Number of Providers Attending by Phase and Country

	Average Number of Providers Attending [Range][a]				
Phase	**Benin**	**Ecuador**	**Jamaica**	**Rwanda**	**Pooled Total[b]**
Labor	2.39 [1–5]	2.39 [1–6]	3.19 [1–9]	2.65 [1–8]	2.79 [1–9]
Intrapartum	1.95 [1–4]	1.83 [1–4]	2.00 [1–7]	1.35 [1–3]	1.80 [1–7]
PP-mother	1.76 [1–4]	2.00 [1–3]	1.88 [1–4]	1.17 [1–3]	1.71 [1–4]
PP-newborn	1.62 [1–3]	1.90 [1–3]	1.88 [1–4]	1.16 [1–3]	1.63 [1–4]
Any phase of observation[c]	1.94 [1–5]	2.02 [1–6]	2.36 [1–9]	1.62 [1–8]	2.02 [1–9]

Notes. a. This table is based on the Combined table data. b. Pooled total weights by total number of cases for each phase (n = 956). c. This row equals the average number of providers listed as attending during the observation, either in one phase or more.

We also analyzed the distribution of the number of providers (Table 9). The distribution was much different for the labor phase than for the others: Three or more providers attended 49% of labor cases compared to only 13–14% of the other three phases. This pattern holds across the four countries, accentuated in some instances. Having the largest country sample, Jamaica most influences the overall pattern.

Table 9. Distribution of Number of Attending Providers by Phase and Country

		Percentage of Cases by Number of Attending Providers				
Phase	Number Attending	Benin % (x/y)	Ecuador % (x/y)	Jamaica % (x/y)	Rwanda % (x/y)	Pooled Total % (x/y)
Labor	1	22.0 (9/41)	27.8 (10/36)	8.2 (8/98)	22.8 (13/57)	17.2 (40/232)
	2	43.9 (18/41)	33.3 (12/36)	30.6 (30/98)	31.6 (18/57)	33.6 (78/232)
	3	12.2 (5/41)	22.2 (8/36)	24.5 (24/98)	22.8 (13/57)	21.6 (50/232)
	4+	22.0 (9/41)	16.7 (6/36)	36.7 (36/98)	22.8 (13/57)	27.6 (64/232)
Intrapartum	1	27.0 (10/37)	29.3 (12/41)	36.5 (23/63)	69.4 (34/49)	41.6 (79/190)
	2	54.1 (20/37)	61.0 (25/41)	46.0 (29/63)	26.5 (13/49)	45.8 (87/190)
	3	16.2 (6/37)	7.3 (3/41)	11.1 (7/63)	4.1 (2/49)	9.5 (18/190)
	4+	2.7 (1/37)	2.4 (1/41)	6.3 (4/63)	0.0 (0/49)	3.7 (7/190)
PP-mother	1	40.5 (15/37)	24.4 (10/41)	34.3 (22/64)	84.8 (39/46)	45.7 (86/188)
	2	45.9 (17/37)	51.2 (21/41)	48.4 (31/64)	13.0 (6/46)	39.9 (75/188)
	3	10.8 (4/37)	24.4 (10/41)	12.5 (8/64)	2.2 (1/46)	12.2 (23/188)
	4+	2.7 (1/37)	0.0 (0/41)	4.7 (3/64)	0.0 (0/46)	2.1 (4/188)
PP-newborn	1	45.9 (17/37)	22.0 (9/41)	39.7 (23/58)	87.3 (48/55)	50.8 (97/191)
	2	45.9 (17/37)	65.9 (27/41)	36.2 (21/58)	9.1 (5/55)	36.6 (70/191)
	3	8.1 (3/37)	12.2 (5/41)	20.7 (12/58)	3.6 (2/55)	11.5 (22/191)
	4+	0.0 (0/37)	0.0 (0/41)	3.4 (2/58)	0.0 (0/55)	1.0 (2/191)

Note. This table is based on the Combined table data.

Two was the most frequent number of providers in the pooled intrapartum (46%) and labor phases (34%), and second most frequent (after one provider) in the two postpartum phases (40% [mother] and 37% [newborn]). A large number of attending providers (four or more) was very rare in the intrapartum and postpartum phases, probably occurring only in cases with complications.

E. SKILLED ATTENDANCE

We calculated the proportion of phase-cases that were attended by skilled providers using the best data source (Combined table). "Skilled team" refers to attending teams of a particular phase-case that include at least one medical doctor, nurse, or midwife. Phase-cases where no such provider attended (i.e., only the "other" category of providers was noted) are termed "less-skilled teams." The Combined dataset indicates

that a skilled team attended 96% of labor cases and 90% of intrapartum cases. This compares to only 84% and 79% of skilled attendance in the PP-mother and PP-newborn phases, respectively (Table 10). Over all countries, an approximate 4–6% decrease occurs in the likelihood of skilled team attendance from the labor to PP-newborn phase. Benin and Rwanda follow similarly, albeit at different rates, while in Ecuador and Jamaica, we found no consistent decrease in the proportion of cases with skilled providers among phases, with the exception of Ecuador's PP-mother phase.

Table 10: Skilled Attendance by Phase and Country

		Percentage of Cases Attended				Pooled
Phase	**Type of Skilled Attendant**	**Benin**	**Ecuador**	**Jamaica**	**Rwanda**	**Total**
Labor	Total: nurse, midwife, or doctor	97.6	91.7	100.0	89.5	95.7
	Nurse/midwife attending	92.3	36.1	99.0	89.5	85.8
	Doctor attending	26.8	63.9	60.2	22.8	45.7
Intrapartum	Total: nurse, midwife, or doctor	94.6	100.0	96.8	69.4	90.0
	Nurse/midwife attending	89.2	36.6	90.5	67.3	72.6
	Doctor attending	10.8	70.7	23.8	2.0	25.8
PP-mother	Total: nurse, midwife, or doctor	89.2	73.2	100.0	65.2	83.5
	Nurse/midwife attending	89.2	22.0	98.4	65.2	71.8
	Doctor attending	5.4	56.1	15.6	2.2	19.1
PP-newborn	Total: nurse, midwife, or doctor	54.1	90.2	98.3	67.3	79.1
	Nurse/midwife attending	54.1	24.2	91.4	67.3	62.8
	Doctor attending	0.0	73.2	12.1	1.8	19.9
Pooled:	Total: nurse, midwife, or doctor	84.2	88.7	98.9	73.4	87.5
All phases	Nurse/midwife attending	81.6	29.6	95.4	72.9	73.9
	Doctor attending	11.2	66.0	32.2	7.7	28.6

In cases where a skilled provider attended, the provider was most often a nurse or midwife. The likelihood of being attended by a nurse or midwife was higher during labor (86%) than during the intrapartum (73%), PP-mother (72%), or PP-newborn (63%) phases. The PP-mother and PP-newborn phases had the highest proportion attended by a less-skilled team, at 17% and 21%, respectively.

Such high attendance by skilled providers during all phases also appeared in each country. In all phases in Ecuador and Jamaica, a skilled provider attended 73–100% of cases. This was true for Benin, except during the PP-newborn phase, when a skilled provider attended only 54% of cases. Skilled teams were less prevalent in Rwanda where skilled attendance was 65% and 67% for the PP-mother and PP-newborn phases, respectively.

Similar to the overall findings, skilled providers in Benin and Jamaica were most often nurses and/or midwives. In Ecuador, however, skilled providers were predominately doctors. For example, a doctor attended 71% of intrapartum cases in Ecuador as compared to 24% in Jamaica, 11% in Benin, and 2% in Rwanda. A similar pattern was observed between Ecuador and the other countries in the postpartum phases.

F. UNDETECTED PROVIDERS

Knowing that some attending providers were recorded ("detected") by the Page 1 method but not the Task-by-task method and vice versa, we expect that some attending providers were not detected by either method. We can estimate the number undetected if we make the limiting assumptions that (1) detection by one method is independent of detection by the other and (2) the probability of detection by a method is the same for a given phase and country.

The appendix uses these assumptions to derive estimates of the probability of detection and of going undetected for each phase and country and overall. Our estimate of the probability that an attending provider will remain undetected over all phases and countries is 2.2%, while 97.8% were detected by at least one method. Among countries, providers were estimated to be undetected most frequently in Benin (3.4%), compared to Jamaica (2.1%), Ecuador (1.8%), and Rwanda (1.4%). Among phases, labor had the lowest rate of providers estimated to be undetected at 1.0%, while intrapartum (2.4%), PP-mother (3.8%), and PP-

newborn (2.2%) were much higher. The pooled country estimated undetected rates for intrapartum and PP-newborn were pulled down by Ecuador, where the undetected rates for these phases were 0% and 0.1%, respectively.

This analysis shows very small rates of non-detection, suggesting that results obtained without consideration of non-detection are valid. Furthermore, even smaller non-detection rates will result to the extent that the assumption of independence is untrue. The assumption of a constant detection probability for each phase and country and the simplifying assumptions made in the calculation (see appendix) may alter the detection probability of a given phase within a country, but are not likely to significantly change the overall pooled probabilities.

IV. DISCUSSION

This study points to the poor performance of both methods in documenting the number and type of all attending providers during normal labor and delivery. Differences in reported numbers of attending providers between the two methods were found in over half the phase-cases, with the Task-by-task method missing 23% of attending providers and the Page 1 method 37%.

Institutionalizing quality assurance requires identifying the best methods for assessing the quality of care. This is especially relevant when measuring provider attendance in order to evaluate the effects of provider team size, team competency, or other enabling factors on quality of care. If the data collection methods used to assess these elements miss data, the ability to identify areas needing improvement will be limited. Consequently, this study has important implications concerning best practices for data collection methods used to improve the quality of care.

Our study suggests that neither the Task-by-task nor Page 1 method should be used alone to assess hospital provider attendance. The large number of differential cases indicates that identification of attending providers is subject to large errors of omission. Only by using the Combined method was documentation of provider attendance least affected by such errors. In any case, approximately 2% of providers among all phases and countries were estimated to have been undetected by any method.

We considered why there were differences in the performance of the two methods, with the labor phase of particular interest because it had the greatest number of attending providers and also the highest percentage of cases with skilled attendance. Two possible factors for the superiority of the Page 1 table during the labor phase are that (1) it may have been easier for observers to forget to add a new name to the Page 1 table during the later phases than during the labor phase because the labor phase section of the form is closest to the Page 1 table, or (2) the labor phase is usually longer and less hurried than the other phases, so observers may have had more time during this phase to fill in the Page 1 table. The Task-by-task method was inferior to the Combined method, possibly because providers who are present during a phase but who do not actually perform a required task are not recorded with the Task-by-task method. Adding space to the form where the observer lists attending providers who did not perform any listed task for a phase might improve the performance of the Task-by-task method.

Though we speculate on potential reasons for differences in the performance of both methods, it is important to note that even in the best circumstances, data collection processes will inevitably omit aspects of the activities they are intended to measure. We recognize that especially in settings where resources (including health information systems) are limited, data collection will not be perfect. This study proposes a way to minimize the effect of incomplete reporting by combining two collection methods to ascertain the best possible data. In this study, implementing the Combined method across phases and in all four countries substantially improved the quality of data collected.

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APPENDIX: ESTIMATING THE NUMBER OF UNDETECTED PROVIDERS

The detection method used here assumes that the two methods compared in this report (Page 1 and Task-by-task) each assume that the detection of an attending provider is a constant probability for a given phase for a country. The detection of the provider is independent of all other factors except the detection probability for that phase in the country. The detection probability is different for the two methods and can be estimated from the data. The number of undetected providers can be estimated from the information thus obtained.

The derivation of the estimate of undetected providers follows. The derivation can apply to any phase for any country—for example, the labor phase for Benin—or to any combination of country-phases. A provider can be counted only once for a particular phase of a given case, but can be counted in more than one phase for that case or more than once in different cases. Let,

Q = Number of providers named by Page 1 method
R = Number of providers named by Task-by-task method
A = Number of providers named by Page 1 method only (undetected by the Task-by-task method)
B = Number of providers named by both the Page 1 method and the Task-by-task method
C = Number of providers named by Task-by-task method only (undetected by the Page 1 method)
D = Number of providers undetected by either the Page 1 or Task-by-task method
T = Total number of providers = A+B+C+D
Pr{x} = Probability of event associated with x

Compute D given A, B, and C.

$Q = A + B$
$R = C + B$
$T = A+B+C+D$
$Pr\{Q\} = Q / T = (A + B) / T$
$Pr\{R\} = R / T = (C + B) / T$
$Pr\{B\} = Pr\{Q\} \times Pr\{R\} = (A+B)/T \times (C+B)/T$
$Pr\{B\} = B / T$

Therefore,

$Pr\{B\} = B / T = (A+B)/T \times (C+B)/T$, and so $B \times T = (A+B) \times (B+C)$
$B \times T = B \times (A+B+C+D) = (B\times A)+(B\times B)+(B\times C)+(B\times D) = (A+B) \times (B+C)$, which yields
$D = (A \times C) / B$.

Table A-1. Number of Detected and Undetected Providers by Phase and Country

	Benin		Ecuador		Jamaica		Rwanda		Pooled Total	
Phase	Detected Providers[1]	Undetected Percent[2]	Detected Providers	Undetected Percent	Detected Providers	Undetected Percent	Detected Providers	Undetected Percent	Detected Providers	Undetected Percent
Labor	98.0	1.6%	86.0	0.8%	312.6	0.7%	151.1	0.7%	647.7	1.0%
Intrapartum	72.2	2.1%	75.0	0.0%	126.0	2.8%	66.2	0.9%	339.3	2.4%
PP-mother	65.1	4.1%	82.0	4.1%	120.3	3.2%	53.8	3.8%	321.3	3.8%
PP-newborn	59.9	4.9%	77.9	0.1%	109.0	3.1%	63.8	2.4%	310.7	2.2%
Pooled total	295.2	3.4%	321.0	1.8%	668.0	2.1%	334.8	1.4%	1619.0	2.2%

Notes. 1. "Detected providers" is number of unique providers named by either method for the subject phase of each case, summed over all cases in the country. 2. "Undetected percent" is the estimated percentage of undetected providers for the subject phase for all cases as a percentage of the number of all estimated providers (detected and undetected) for the subject phase summed over all cases in the country.

The number of detected providers for a given phase and country was estimated as the number of cases (from Table 6) multiplied by the average number of providers per case (from Table 7) for that phase and country. A provider who was recorded twice as attending the same phase of the same case (for example, one recorded by both methods) was counted as only one provider. However, a single provider who was recorded as attending two or more phases of the same case was counted in each phase where recorded, and a single provider recorded in more than one case was counted in each of those cases.

To estimate the number of undetected providers for a phase and country, we assumed that the average number of providers per case was the same for all four better data categories in the phase and country (from Table 7). (The four better categories are: Same, Page 1 better, Task-by-task better, Combined better.) Then, to calculate the total number of unique providers for each better category in a phase-country, we multiplied the number of cases in the better category (from Table 5) by the average number of providers per case for that phase-country (from Table 7). Next, we allocated the number of unique providers in each better category to A, B, and C as follows (A is the number of providers named by the Page 1 method only; B is the number of providers named by both methods; C is the number of providers named by the Task-by-task method only):

Same:	All to B
Page 1 better:	A gets number of providers equal to number of cases; remainder to B
Task better:	C gets number of providers equal to number of cases; remainder to B
Combined better:	Both A and C get half the number of providers equal to number of cases; remainder to B

This allocation assumes that, on average, the “Page 1 better” phase-cases had one more provider named by the Page 1 method than the Task-by-task method, the “Task better” phase-cases had one more provider named by the Task-by-task method than by the Page 1 method, and the “Combined better” phase-cases had one-half a provider more named by each method. This allocation is approximate and only made necessary by our use of the average providers per case procedure.

The results of this allocation enabled us to compute estimates of A, B, and C for each phase within countries. Given A, B, and C, we could compute D for each phase within country using the formula D = (AxC)/B.

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