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2 **SUPPLEMENT TITLE:**

3 *Every Newborn* BIRTH multi-country validation study: informing measurement  
4 of coverage and quality of maternal and newborn care

5

6 **PAPER TITLE:**

7 **Barriers and enablers to routine register data collection for**  
8 **newborns and mothers: EN-BIRTH multi-country study**

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36 **ABSTRACT**

37 **Background:** Policymakers need regular high-quality coverage data on care around the time of birth  
38 to accelerate progress for ending preventable maternal and newborn deaths and stillbirths. With  
39 increasing facility births, routine health management information system (HMIS) data have potential  
40 to track coverage. Identifying barriers and enablers faced by frontline health workers recording HMIS  
41 source data in registers is important to improve data for use.

42 **Methods:** The EN-BIRTH study was a mixed-methods observational study in five hospitals in  
43 Bangladesh, Nepal and Tanzania to assess measurement validity for selected *Every Newborn*  
44 coverage indicators. We described data elements required in labour ward registers to track these  
45 indicators. To evaluate barriers and enablers for correct recording of data in registers, we designed  
46 three interview tools: a) semi-structured in-depth interview (IDI) guide b) semi-structured focus  
47 group discussion (FGD) guide, and c) checklist assessing care-to-documentation. We interviewed two  
48 groups of respondents (January 2018-March 2019): hospital nurse-midwives and doctors who fill  
49 ward registers after birth (n=40 IDI and n=5 FGD); and data collectors (n=65). Qualitative data were  
50 analysed thematically by categorising pre-identified codes. Common emerging themes of barriers or  
51 enablers across all five hospitals were identified relating to three conceptual framework categories.

52 **Results:** Similar themes emerged as both barriers and enablers. First, register design was recognised  
53 as crucial, yet perceived as complex, and not always standardised for necessary data elements.  
54 Second, register filling was performed by over-stretched nurse-midwives with variable training,  
55 limited supervision, and availability of logistical resources. Documentation complexity across parallel  
56 documents was time-consuming and delayed because of low staff numbers. Complete data were  
57 valued more than correct data. Third, use of register data included clinical handover and monthly  
58 reporting, but little feedback was given from data users.

59 **Conclusion:** Health workers invest major time recording register data for maternal and newborn  
60 core health indicators. Improving data quality requires standardised register designs streamlined to

61 capture only necessary data elements. Consistent implementation processes are also needed. Two-  
62 way feedback between HMIS levels is critical to improve performance and accurately track progress  
63 towards agreed health goals.

64 **Keywords:** Birth, Maternal, Newborn, Coverage, facility registers, indicators, data quality, Health  
65 Management Information Systems

66

## 67 **Key findings**

### **What is known and what is new about this study?**

- Routine facility register data recorded in Health Management Information Systems (HMIS) in low- and middle-income countries (LMIC) provide an opportunity to close data gaps for tracking coverage of care at birth. Although around four-fifths of the world's births are now in facilities, labour ward register data are currently under-used and under-studied. Specifically, few studies have examined barriers and enablers for recording high quality routine maternal and newborn data, or on the use of labour and delivery ward registers.
- EN-BIRTH was the first multi-country mixed-methods study to assess validity of register-recorded maternal and newborn coverage indicators. In the three study countries, we found register coverage measurement accuracy varied, even between hospitals in the same country using the same registers.
- Hence to assess barriers and enablers for health workers to record data in labour ward registers, we interviewed health workers (n=72) and EN-BIRTH research data collectors (n=65) across the five hospitals.

### **What did we find and what does it mean?**

- **DESIGN** of national labour ward registers varied between the study countries, capturing between 35-58 data elements, duplicative with other recoding in other documents. Coverage

indicators of interest (uterotonics, early initiation of breastfeeding and neonatal bag-mask-ventilation) are recorded in registers in Bangladesh and Tanzania but not in Nepal.

Standardisation of registers and linkage of these registers to digital HMIS is urgently needed for global tracking. Registers also need local ownership to streamline with local facility documentation requirements, this is critical to reduce burden on frontline health workers.

- **FILLING** processes of routine registers are not systematically implemented within or between countries. Completeness was more highly valued than accuracy. Consistency and accuracy could be promoted by training and supportive supervision to realize the potential of this data source.
- **USE** of register data are impeded by lack of trust in its quality. Promotion of the importance of health facility data for clinical quality improvement, and monitoring is needed to improve data quality and use. Feedback from data users at supervisor/manager and district levels could increase the value frontline health workers attribute to these data and promote their use at the place of care.

#### **What next and research gaps?**

- Routine labour ward register data can be used now to contribute vital data around the time of birth. Implementation research is required on interventions to standardise labour ward register designs, and the processes for filling them with regular data quality review. Such research could test an improvement package to include a two-way data flow system up from labour ward registers into HMIS, and feedback returning to the facility.

68

## 69 **Background**

70 Data gaps to track care around the time of birth in low- and middle-income (LMIC) settings impede  
71 action towards goals to end more than five million deaths annually of newborns, stillbirths and  
72 women [1-4]. Although >80% of the world's births occur in facilities [5], routine records are under-

73 utilised as a data source for maternal and newborn care. The *Every Newborn* Action Plan (ENAP),  
74 agreed by all United Nations member states and >80 development partners, includes an ambitious  
75 measurement improvement roadmap with an urgent focus to improve measurement around the  
76 time of birth, especially routine HMIS data [6]. Sustainable Development Goal 17 “Revitalise the  
77 global partnership for sustainable development” includes a specific target to increase the availability  
78 of high-quality, timely and reliable data [7]. Population-based surveys remain a major source of  
79 maternal and child health data in LMIC [8-10]. Such household surveys—e.g. the Demographic and  
80 Health Surveys (DHS) [11] and Multiple Indicator Cluster Survey (MICS) [12, 13]—occur every 2-5  
81 years and collect information regarding births over the preceding 2 to 5 years, thus are not designed  
82 to tracking progress on a month-to-month, or year-to-year, basis [1, 14-16].

83 Routine health management information system (HMIS) data, in contrast, have potential to be  
84 available more regularly and used for more timely action by health workers, facility/district  
85 managers and policy makers [17]. The expansion of digital platforms e.g. District Health Information  
86 Software 2 (DHIS-2), in LMICs in recent years has increased awareness of the potential of HMIS to  
87 improve data availability at subnational level and above [18]. HMIS data from facilities, may not be  
88 population representative as household surveys are, although as facility births rise, facility data  
89 around the time of birth are increasingly useful. However, HMIS data quality has historically been  
90 considered poor, so increasing data quality and trust are essential [19, 20]. Studies in LMICs have  
91 shown how data use positively impacts quality of care and helps strengthen health systems [21, 22].  
92 Performance of routine information system management (PRISM) framework illustrates the multiple  
93 factors (organisational, technical and behavioural) that influence data quality and information use  
94 (Table 1) [23, 24]. Routine register data are usually the source for HMIS facility data. Paper registers  
95 are books, typically located on a hospital ward and contain a limited number of data elements as a  
96 parallel and usually duplicate system to individual patient case notes. Health workers record each  
97 admitted individual women/newborn on one row in the register with data regarding care practices  
98 and interventions in columns allotted either for “specific” data elements (e.g. bag-mask-ventilation)

99 or “non-specific” data elements (e.g. other details). Previous studies have assessed availability and  
100 completeness of data elements for maternal and newborn coverage indicators in routine registers  
101 [25, 26]. Data for local and higher health system use in HMIS are typically aggregated from registers  
102 monthly, using paper tally sheets and/or summary forms. Data culture within the health facility  
103 influences register data collection, analysis and use [27].

104 The *Every Newborn* – Birth Indicators Research Tracking in Hospitals (EN-BIRTH) study was a mixed  
105 methods observational study in three countries (Tanzania, Bangladesh and Nepal). EN-BIRTH aimed  
106 to assess measurement validity of newborn and maternal indicators for routine facility-based  
107 tracking of coverage, quality of care, and outcomes (21). Indicators were selected based on criteria  
108 outlined in global frameworks [6, 28, 29]. The EN-BIRTH validation assessment reported finding  
109 register-recorded coverage accuracy varied by indicator and by hospital [30].

## 110 **Objectives**

111 This paper is part of a supplement based on the EN-BIRTH multi-country study, ‘Informing  
112 measurement of coverage and quality of maternal and newborn care’. The purpose of this paper is  
113 to explore general barriers and enablers for health workers to record high-quality (complete and  
114 accurate) data in labour ward registers only. Data recorded in registers in neonatal and kangaroo  
115 mother care wards are explored in other papers in the supplement [31, 32]. This paper has three  
116 objectives:

117 **Objective 1: Describe the STRUCTURE OF ROUTINE LABOUR WARD REGISTERS** for measurement of  
118 coverage of key maternal and newborn health intervention indicators.

119 **Objective 2: Identify BARRIERS AND ENABLERS** for health workers to record and use labour ward  
120 register data for measurement of coverage of key maternal and newborn interventions.

121 **Objective 3: Explore the PROCESSES of labour ward health care provision and register**  
122 **documentation** including flow and sequence, by health workers for key maternal and newborn  
123 interventions at birth.

## 124 **Methods**

### 125 **Study sites and overview**

126 EN-BIRTH study was conducted in five public hospitals in three high burden mortality countries:  
127 Maternal and Child Health Training Institute (MCHTI) Azimpur and Kushtia District Hospital in  
128 Bangladesh (BD), Pokhara Academy of Health Sciences in Nepal (NP), and Temeke Regional Hospital  
129 and Muhimbili National Referral Hospital in Tanzania (TZ) (Additional file 1). These comprehensive  
130 emergency obstetric and newborn care (CEmONC) hospitals were selected since they provided the  
131 interventions of interest across several different wards. Labour ward register findings for three  
132 indicators (uterotonics to prevent post-partum haemorrhage, early initiation of breastfeeding and  
133 neonatal bag-mask-ventilation) will be reported in this manuscript; other ward findings are reported  
134 in separate manuscripts [31-33]. The multi-partner research team co-designed the tools and  
135 collected data from January 2018 to March 2019.

136

### 137 **Objective 1: Structure of routine labour ward registers**

138 We reviewed the design structure for labour ward registers to summarise: total number of data  
139 elements captured; selected indicator data elements column name, column type (specific or non-  
140 specific) and how the column was completed if the intervention was either given, or not given.

### 141 **Objective 2: Barriers and enablers for health workers to record and use register data**

142 The research team, using a literature review, identified the PRISM conceptual framework (Table 1)  
143 and used these constructs to design guides for semi-structured in-depth interviews (IDI) and for  
144 focus group discussions (FGD) (Additional file 2). The guides explore routine labour ward register  
145 documentation in general, with specific open-ended questions about selected indicators (Additional



146 files 3, 4) [33]. Tools were developed in English, translated to local languages (Bengali, Nepali and  
147 Swahili), then piloted, revised and back translated into English.

148

### 149 ***Respondents and data collection***

150 We purposively selected two groups of respondents: (i) Health workers (nurses/midwives/doctors)  
151 from the study hospitals routinely caring for women/newborns and are responsible for recording in  
152 ward registers; and (ii) EN-BIRTH study researchers (clinical observers, data extractors and  
153 supervisors) who were present for more than 9 months on the study site wards, for an external  
154 perspective on the register documentation process [33].

155 At least two IDIs were conducted in each site for each category of respondent. The sample size for  
156 the interviews was determined using saturation sampling: additional respondents were interviewed  
157 until no new information was learnt by the investigators in each site. One FGD including at least one  
158 health worker from each ward was added for triangulation. Data were collected by experienced  
159 qualitative researcher co-authors in two phases: January-June 2018 from EN-BIRTH study data  
160 collectors and January-March 2019 for EN-BIRTH study hospital health workers. Interviews were  
161 conducted in local languages in a private room, and audio recorded after obtaining informed  
162 participant consent.

### 163 ***Data management and analysis***

164 Data transcription, translation into English, code-book design and analysis were carried out in  
165 country by the same co-authors involved with tool design and data collection after all data had been  
166 collected. All transcripts were read multiple times by team members prior to developing the code  
167 book for familiarization. A coding template in NVivo software version 12 [34] was jointly developed  
168 based on the PRISM framework (Additional files 5, 6) and the codebook. Framework analysis was  
169 used to support comparing, and to differentiate between IDI and FGD findings [35]. Two coders from  
170 each country team coded the same 2-4 interviews and compared results. Any discrepancies were

171 discussed, which increased inter-coder reliability [36]. Differences were reconciled with discussion or  
172 involvement of another team member and single individuals coded remaining transcripts. The multi-  
173 country team reconciled coding issues on weekly calls and the code book was modified where  
174 necessary.

175 For the health worker-register interface, the EN-BIRTH team created a framework based around  
176 three categories: register design, register filling and register use. We applied this conceptual  
177 framework to identify emerging themes across all sites. Two analysis workshops and multiple multi-  
178 country calls were held to agree upon the main themes emerging from the IDIs and FGDs, and to  
179 synthesise the findings. The consolidated criteria for reporting qualitative research (COREQ) checklist  
180 guidelines were followed throughout (Additional file 7) [37].

181

### 182 **Objective 3: Processes of care and documentation including flow and sequence**

183 To identify how health care provision and labour ward register documentation relate to one another  
184 on labour ward, we designed a third tool called the “care-to-documentation checklist” (Additional  
185 file 8**Error! Reference source not found.**). This tool captured the process, flow and sequence of  
186 recording data in registers by selected indicators: which health worker cadre usually/ sometimes  
187 provides the care?; which cadre records the care?; what is the order of documentation in labour  
188 ward documents (among register, patient notes, drug charts, partograph)?; what is the estimated  
189 time in minutes between intervention given and documentation. These close-ended questions were  
190 asked by the researcher to respondents, immediately after their IDI (but not to FGD respondents).  
191 The checklist data were entered on Excel and proportions and sequence were analysed in R version  
192 3.6.1 [38].

## 193 **Results**

### 194 **Objective 1: Structure of routine labour ward registers**

195 We identified two types of registers on the labour wards: formal pre-printed and informal hand-

196 written registers, which are typically facility-specific for programme or quality improvement  
197 purposes (Additional file 9). All study hospitals used nationally developed, formal paper-based  
198 registers; in Bangladesh, a national register was introduced during the early phase of the study,  
199 replacing previously existing, hospital-specific ones. In Muhimbili (TZ), the informal “Perinatal  
200 Research Register” has been in continuous use for more than twenty years [39]. In Temeke (TZ), one  
201 nurse-midwife was assigned, to send summary data every day from the register to HMIS and had no  
202 other clinical responsibilities. The total number of data elements captured in formal register columns  
203 was: 58 in Bangladesh, 35 in Nepal and 48 in Tanzania (Table 2). One data element was captured per  
204 column in the register in Tanzania, but more than one in some columns of the registers in  
205 Bangladesh and Nepal. Data elements needed as numerators for the three selected coverage  
206 indicators were captured in the Bangladesh and Tanzania registers but not in the Nepal register. In  
207 Bangladesh register columns were ticked when the intervention/practice was done and left blank  
208 when not done compared to Tanzania, where register columns were filled with yes/no in Swahili,  
209 except for bag-mask-ventilation, which was completed with a numerical code (Additional file 10).

210

## 211 **Objective 2: Barriers and enablers for health workers to record and use register data**

212 A total 72 health workers (62 nurse-midwives and 10 medical doctors) and 65 data collectors were  
213 interviewed for this study (Table 3); background characteristics of participants are shown in  
214 Additional file 11.

215

216 Twelve themes common to all hospitals emerged by applying the conceptual framework of register  
217 design, register filling and register data use. The themes are summarised in Figure 1 to show how  
218 these common themes operated as either enablers (in green) or barriers (in red) because  
219 respondents expressed the same themes as both promoting and limiting register recording accuracy  
220 and use. The themes are shown radiating from the conceptual framework to illustrate how these

221 themes were described as influencing one another and the hospital data culture. Each theme is  
222 summarised in turn below.

223

## 224 **1. Register Design**

225 Three themes emerged:

### 226 **a. Complexity**

227 The labour ward registers were described as complex by many respondents in Tanzania and  
228 Bangladesh:

229 *“it is complicated somehow, first it is large and that book [register] contains a lot  
230 of details to be filled although all of them are important....”*

231 *-IDI, L&D Nurse-midwife, Muhimbili, TZ*

232 Additionally, the data elements recorded in the formal labour ward register need to be duplicated  
233 in multiple other documents (e.g. informal registers, patient notes) as complex registers form part  
234 of documentation system that is not streamlined and is burdensome:

235 *“We need to do the same documentation, again and again in three to four  
236 different places, which needs us to give a lot of time.”*

237 *-IDI, L&D Nurse-midwife, Azimpur, BD*

238

### 239 **b. Standardisation with necessary data elements**

240 Health workers from the Nepal and Bangladesh sites acknowledged all the data elements they  
241 needed were captured.

242 However, in Tanzania, not all data elements needed to complete monthly reporting forms for HMIS  
243 were in the labour ward registers:

244 *“I enter entire patient’s information, ....and I sometimes have to add some columns*  
245 *where I can include some data that I know is important and should be written to help*  
246 *me with my end of the month report. So, if I were to just follow the register it means*  
247 *some data could be missed and that’s the challenge that I encounter.”*

248 *-FGD, Nurse-midwife, Muhimbili, TZ*

249

250 **c. Paper or electronic**

251 All five hospitals were using paper-based registers, but respondents mentioned forthcoming  
252 transition to electronic platforms, which were anticipated to be desirable, to save time, and to  
253 improve data completeness, availability, and storage:

254 *“Documentation till today is done in traditional way. However, writing that every*  
255 *day, is time loss. Further, if we had computerised system, it would have been very*  
256 *better, it could last for later....”*

257 *-IDI, L&D Nurse-midwife, Pokhara NP*

258 Yet many respondents expressed their need for computer training, some suggested extra staff  
259 would need to be recruited to manage digitised registers:

260 *“To operate the computer for documentation, we need both manpower and proper*  
261 *training. For example, if we had three more staffs in this ward, two staffs will work*  
262 *for caring the patient and the other one will engage with documentation and can*  
263 *handle the computer. It will allow us to perform other things more easily.”*

264 *-IDI, L&D Nurse-midwife, Azimpur BD*

265

266 **2. Register Filling**

267 Six themes emerged:

268 **a. Health worker responsibility**

269 In all five hospitals nurse-midwives alone owned the task of labour ward register recording  
270 described as within their current nursing role. Data quality responsibility was perceived to be better  
271 when the same nurse-midwife providing the care documented in the register:

272 *“For effective recording and reporting, the one who provides the care should*  
273 *herself do the documentation and then only it is complete and proper. A third person*  
274 *asked to document is not proper – there will be missing in recording and reporting.*  
275 *Manpower should be sufficient so the one who does the care should only perform*  
276 *recording and reporting.”*

277 -FGD, Nurse-midwife, Pokhara NP

278 However, task shifting of documentation to other actors was highly valued by several respondents,  
279 although difficult to obtain, especially during night shifts:

280 *“It is super difficult to get support from students even the intern doctor and the*  
281 *trainee nurses don’t help us in documenting the information in register.”*

282 -FGD, Nurse-midwife, Kushtia BD

283

284 **b. Training for competence**

285 Respondents from Nepal described attending a short training on register filling as an enabling factor  
286 for register data recording. Tanzanian respondents stated they had been shown “on the job” how to  
287 fill the register and the lack of specific formal training or instructions for register filling was a barrier  
288 to documentation. In Bangladesh, only computer training had been received:

289 *“We have not got any training related to register fill up. We were given only an*  
290 *orientation on computer but couldn’t learn anything. It was too short i.e. 2 to 3 days.”*

291 -IDI, L&D Nurse-midwife, Azimpur BD

292

293 **c. Time required to document**

294 Respondents expressed the large amount of time spent on documentation in general, even in the  
295 Nepal site with the lighter register design:

296 *“If we work 7 to 8 hours duty, it usually takes around 3 hours to do*  
297 *documentation.”*

298 -IDI, Nurse-midwife, Pokhara NP

299 *“In a period of eight hours of my shift, if I have a large number of patients, I may*  
300 *spend more time in documentation than the time I spend in attending the*  
301 *patients”*

302 -IDI, L&D Nurse-midwife, Muhimbili TZ

303 In all three countries, respondents related the time challenge of completing registers to the  
304 availability of the health work force:

305 *“Our main difficulty to fill up the register appropriately, is shortage of manpower.*  
306 *We have to suffer a lot to do quality documentation due to short of*  
307 *manpower.”*

308 -IDI, L&D Nurse -midwife, Azimpur BD

309 The tension between being too busy to always document immediately after care led to lower  
310 quality data:

311 *“You find you are having say three patients and they all need care, you will start*  
312 *with the first one, after that you can’t do the documentation, you will have*  
313 *to attend the second and the third, now as you go for documentation it will*  
314 *be difficult to remember exactly figures or details, for example it is difficult*  
315 *to remember exactly the time for each of them so, you will have to*

316 *estimate, maybe if you have enough staff, one does the attending and*

317 *another do the documentation”*

318 *-IDI, Nurse-midwife, Muhimbili TZ*

319

320 **d. Logistical resources needed**

321 New registers were usually available but sometimes the stock were locked in stores. Pens were only

322 available in some hospitals:

323 *“There is still a challenge of resources, for instance now we are asked to*

324 *document but they don’t think if pens are provided, instead you have to buy*

325 *yourself. You are supposed to write....and there are some things which I would*

326 *like to write them if they would provide me with tools. Honestly resource is very*

327 *challenging”*

328 *-FGD, Nurse-midwife, Muhimbili TZ*

329 The organisation of the large registers laying on a table at the nursing station were described as a

330 logistical barrier by some respondents:

331 *“When she is done she will go to the nursing station to do her documentation in*

332 *register book, then fills the midwifery book, the books are in different places and*

333 *are far from the patient or the delivery room”*

334 *-IDI, EN-BIRTH Data Collector, Muhimbili TZ*

335

336 **e. Supervision for data quality**

337 Supervision of register filling processes was acknowledged to be an important enabler to register

338 filling by most respondents, yet was not occurring regularly in every hospital:



339 *“We never had any sorts of supervision about the documentation.”*

340 -IDI, L&D Nurse-midwife, Azimpur, BD

341 *“The only things that displays the work of health workers are the*

342 *documentations...important for supervisors as well. If we show them the recorded data,*

343 *they get to advise us about the errors and whether it [register] is complete or not. So it*

344 *becomes important in supervision as well.”*

345 -IDI, L&D Nurse-midwife, Pokhara NP

346

347 Register documentation supervision was expressed as being linked to data quality:

348 *“They normally come to verify their data on register books and if there is any problem, they*

349 *tell you that here you are supposed to do this and that. This is how is being done....It is*

350 *educative system because if she criticise you she must explain to you”*

351 -FGD, Nurse-midwife, Temeke TZ

352 Many respondents expressed that completeness was important and the need to “fill the gaps” in

353 registers:

354 *“.....there a big delivery book which has headings therefore, you can’t skip even a*

355 *single box all of them must be filled.”*

356 -FGD Nurse-midwife, Muhimbili TZ

357

358 **f. Motivation**

359 Appreciation from supervisors was articulated by one respondent as an important motivator, and

360 was also linked with higher quality documentation:

361 *“We receive praise, when everything (related to documentation) is good and it*  
362 *works as a motivation to continue documentation with care.”*

363 -IDI, L&D Nurse-midwife, Azimpur BD

364 By contrast, many health workers noted the lack of acknowledgement and/or recognition served as  
365 a motivational barrier for high quality register recording:

366 *“There is not any formal award or recognition like that. Instead we get scolded if*  
367 *it’s left. We are not appreciated for writing.”*

368 -FGD, Nurse-midwife, Pokhara NP

369

### 370 **3. Register Use**

371 Three themes emerged regarding perceived register data utility:

#### 372 **a. Demand for data**

373 Respondents expressed varied register data demands as enablers. Nurse-midwife respondents  
374 mainly described how they themselves used the data for patient handover:

375 *“We are documenting because even nursing itself is a continuous process ....so if*  
376 *you did not document, the other nurse will not know where you ended, so*  
377 *documentation is still very important”*

378 -FGD, Nurse-midwife, Temeke TZ

379 The same register data were used by supervisors for management decisions:

380 *“Even the hospital itself insists so much on documentation... if you don’t*  
381 *document, sometimes it becomes very difficult for the management to get*  
382 *revenue to know how many people should get what medicine, you have to*

383 *document on health insurance and normal patients”*

384 -FGD, Nurse-midwife, Temeke TZ

385

386 In Nepal, a doctor respondent expressed that data were used in research and for  
387 indicators:

388 *“We also have doctors and students utilising the data. It is used for the research*  
389 *and general information. We create health indicators and send to central level*  
390 *and they also create national health indicators. And the ultimate goal for all is to*  
391 *know how the health indicators are. It helps to do planning accordingly.”*

392 -IDI, L&D Doctor, Pokhara NP

393

394 **b. Feedback to health workers**

395 Provision of feedback from HMIS users of register data to those who had collected the data, was  
396 perceived to be an enabler; however respondents said feedback hardly ever happened:

397 *“I haven’t got any feedback from them (HMIS) about documentation. There sits*  
398 *monthly meeting in hospital with data people. We don’t usually participate in*  
399 *that meeting.”*

400 -IDI L&D, Nurse-midwife, Azimpur BD

401 *“It doesn’t come to us directly. We don’t have much information.”*

402 -FGD, Nurse-midwife, Pokhara NP

403

404 **c. Trust in data quality**

405 Some health worker respondents stated that lack of trust in register data quality was a barrier to  
406 the usefulness of register data:

407 *“Sometimes, variables are missing and when research needs to be done then it is*  
408 *not ineffective.”*

409 -IDI, L&D Doctor, Pokhara NP

410 *“There is hardly missing areas in the register- if we find some we try to collect the*  
411 *information either by asking the patient again or nurse who attended the*  
412 *delivery. Using good quality data are important to decision make”*

413 -IDI, L&D Nurse, Kushtia BD

414

### 415 **Objective 3: Sequence of care and documentation**

416 Analysis of the care-to-documentation checklist showed that the nurse-midwife who provided the  
417 intervention/practice usually also recorded in the labour ward register (Additional file 12). However  
418 data collector respondents stated that health workers sometimes documented care provided by a  
419 colleague (Additional file 13). Among all documents to be filled, the labour ward register were  
420 described as the first to be completed in both Bangladeshi hospitals, but the order varied between  
421 first to third in the Tanzanian hospitals (Additional files 14, 15). The average estimated time between  
422 care provision and register documentation ranged from 10 to 28 minutes as reported by health  
423 workers and was 9 to 34 minutes based on data collectors’ report (Additional file 16).

## 424 **Discussion**

425 EN-BIRTH study is the first LMIC multi-country assessment of barriers and enablers to labour ward  
426 register data recording. We add to previous research regarding barriers regarding routine facility  
427 data recording from antenatal clinics and human immunodeficiency virus (HIV)/AIDS programme  
428 data [1, 40, 41]. We found twelve consistent themes reported in all five hospitals across our

429 conceptual framework of register design, filling and use. Figure 1 depicts the relationship between  
430 use of register data, which should affect register *design*, which will affect register *filling*, which will  
431 affect register data use. The twelve themes identified within these categories were described as  
432 either enablers or barriers by respondents in the five hospitals. We postulate that the varying  
433 interaction of these themes in each study hospital contributed to the variation in accuracy in  
434 measurement of labour ward indicators as identified in the EN-BIRTH validation study [30]. These  
435 data practice themes act within, and likely contribute to, a wider hospital data culture of accepted  
436 and normative practices, which permits health workers to collect high-quality register data that can  
437 be trusted for use.

438

439 Improved HMIS performance is increasingly recognized as a priority to improve coverage and quality  
440 of care as described in the comprehensive PRISM framework, which demonstrates the many  
441 interacting constructs needed for high-quality data for use [23, 24]. This EN-BIRTH study used the  
442 PRISM constructs to explore the barriers and enablers to recording at the service user-register  
443 interface and for health workers. We found register design complexity and the burden of data  
444 collection was a cross-cutting finding across the study sites. The sheer volume of data elements  
445 captured in these national register designs was striking. Nepal had the lightest register design, yet  
446 captured 35 data elements, compared to 48 in Tanzania and 58 in Bangladesh. Notably, data  
447 elements more than doubled when national registers were introduced in Bangladesh. Yet labour  
448 ward registers did not always match monthly reporting requirements, necessitating nurse-midwives  
449 to use their own initiative and add columns to registers, or start informal registers, to capture  
450 required data. Complexity of documentation was described as encroaching upon the time health  
451 workers can dedicate to midwifery care. Our findings align with a study describing the balance  
452 between service provision and documentation practices in Uganda [42]. Several causes contribute to  
453 this high burden of register data collection, including a lack of coordination regarding which  
454 indicators (and contributing data elements) are selected for tracking, multiple reporting flows and

455 additional data element capture to signal rigor or research [43]. Frontline health workers have dual  
456 responsibilities of providing care and documentation of that care. With the typically high user-to-  
457 staff ratios of facilities in many LMIC settings, urgent attention to reducing any unnecessary  
458 documentation would support efforts to improve quality of care by health workers for women and  
459 babies.

460

461 Filling of registers was not systematised or consistently supported by effective logistics and supplies,  
462 even non-availability of pens and registers was cited by some respondents. Bedside care provided by  
463 the health worker was documented in one register located on a table in the labour ward. The  
464 documentation was described as done within 30 minutes of the care practice/intervention whilst the  
465 health worker was still responsible for the women and her baby during the critical first hour after  
466 birth. The cumulative effect of distance between point of care and point of register documentation,  
467 simultaneous responsibilities of care and documentation for a large number of data elements to be  
468 recalled could account for both under and over-reporting of interventions, as found in the EN-BIRTH  
469 observational validation study [30].

470

471 Perceived value of labour ward register data by data users in these large CEmONC hospitals was a  
472 further cross-cutting issue that likely affects data quality [30]. Data-specific training was perceived by  
473 health workers as enabling, yet few had received in-service training on how to complete registers.  
474 Supportive supervision for register recording was not a priority, as described by both health workers  
475 and research data collectors. Data completeness was expressed as more highly valued compared to  
476 data accuracy by health workers and data collectors alike. This may be driven by column filling  
477 (completeness) being feasible to visualise in registers by health workers and supervisors, and thus a  
478 signal and symbol of professionalism [44]. Although notably in Bangladesh completeness for  
479 coverage numerators cannot be calculated as registers are designed for columns to be left blank  
480 (true zero) when interventions are not performed.

481

482 Use of register data was valued by health workers for clinical care handover or other hospital use,  
483 however none of the nurse-midwife respondents who actually fill registers mentioned use for  
484 tracking coverage or impact of services at higher levels of the health system. Increasing demand for  
485 labour ward register data use is needed. Using register data at facility level to improve quality of  
486 care or to supervise performance was mentioned could link to priority setting and health unit  
487 management also at sub-national level. National data demand includes for strategic planning and  
488 policy. Health workers around the world invest considerable time documenting large volumes of  
489 data. Nurse-midwives deserve to be informed about the value of the data they collect for wider  
490 decision making, and to be appreciated for their work in collecting it.

491

492 Enabling environments are needed for health workers to provide care and are often measured as  
493 “service readiness” [45]. Similarly, enabling “data readiness” is necessary to promote high-quality  
494 register data to flow into HMIS. An integrated approach is needed to transform routine data on  
495 labour wards, taking into account the midwife’s dual role in care provision and data recording [20].  
496 The information culture at facility level and throughout the system is important. Decentralised data  
497 use in facilities may incentivise improving data quality [46, 47]. By increasing data visibility through  
498 feedback to frontline health workers about data use, data quality has been shown to improve in  
499 registers [14, 19, 22-24, 48-50]. However a notable finding from our labour ward register study was  
500 the low level of two-way feedback loops between different levels of the data pyramid – nurse-  
501 midwives collecting register data and other data users higher up in the pyramid [51, 52].

502 Paper-based systems remain the norm in most LMIC labour wards, yet these often feed into digital  
503 systems [53]. However, care should be taken not just to digitise poor information systems. There has  
504 been rapid expansion of digital HMIS in LMIC with increased IT capability to improve data quality  
505 (automated checks, validation rules, visualizations, etc.) [1, 46, 47, 54]. Poor quality of care has been

506 described as “too much too soon, too little too late” [55]. Similarly, in response to “too little data too  
507 late”, care is needed to avoid digitisation of routine data creating “too much data too soon”. Unless  
508 we turn our attention to reduce unnecessary data and improve reliability and quality of the register  
509 data, the value of digital HMIS data for clinical and programmatic decision making will not be  
510 realised. The risk is that labour ward routine register data will remain in a “vicious cycle of data  
511 quality”, if data are not trusted, they are is not used. If data are not used, investment in data quality  
512 suffers, and data quality deteriorates even further. Thus, simultaneous action on both data use and  
513 data quality is necessary to break this cycle. In practice, this means increasing use of current labour  
514 ward register data, whilst investing in improving data quality. Current data quality reviews typically  
515 compare HMIS monthly reports using register data as the standard [56]. Innovative ways to routinely  
516 include assessment of the quality of the source register data are important to consider. Register data  
517 assessment can be linked to routine quality improvement initiatives that use routine data, such as  
518 maternal and perinatal death surveillance and response. Checking accuracy of register data quality  
519 compared to patient case notes during such perinatal audit meetings and involving health workers,  
520 could be one effective way for feedback and linking quality of data, and quality of care. Without  
521 focused action to improve routine data quality, tracking progress using HMIS data towards agreed  
522 Sustainable Development Goals and ENAP targets by 2030 will be suboptimal [53].

523

#### 524 **Strengths and limitations**

525 A strength of our study is multi-sites public hospitals in three high burden LMICs. We used common  
526 tools that were co-designed by our team including the PRISM framework determinants. We  
527 interviewed health workers involved in the process themselves and EN-BIRTH research data  
528 collectors who had worked day and night on the labour ward for >9 months, for an external  
529 perspective. The use of open-ended and close-ended questionnaires allowed us to generate a broad



530 range of common findings issues across sites. Our predetermined codes were based on the PRISM  
531 framework and all sites used NVivo in a collaborative analysis process.  
532 However, our study also has limitations. There was a possible desirability bias by health workers,  
533 which might have led to either under- or over-reporting of the challenges faced. The “care-to-  
534 documentation checklist” dataset analysis was stratified by type of respondent (health worker and  
535 data collector), by indicator and by site. The qualitative data analysis presented in this paper was to  
536 identify common barriers and enablers for labour ward register recording across all indicators used  
537 health worker and data collector responses together. Indicator-specific mixed-methods linked  
538 analyses will be presented in other linked papers to further explore subthemes and differences  
539 between cadres [57-62]. It was beyond the scope of this study for the EN-BIRTH data collectors to  
540 directly observe or measure the detailed process of register filling (e.g. time, logistics availability,  
541 supervision, use for reports). All hospitals were peri-urban CEmONC hospitals, which may limit  
542 generalizability to facilities at lower levels of the health system.

543

#### 544 **Research for improving measurement**

545 Further research is needed to explore barriers and enablers in other settings and at different levels  
546 of the health system to understand the broader relevance of the themes we identified. Our  
547 exploratory research identified twelve themes that could be used to design shorter tools for routine  
548 register data capture and use, a component of HMIS that is relatively under-represented in existing  
549 tools [27, 56]. Implementation research is required for all three components we identified regarding  
550 registers in our conceptual framework (design, filling, use). To enable national or district tracking of  
551 core indicators in HMIS, the priority data elements that are being harmonized at higher levels of the  
552 data pyramid will need to be included in register design [63, 64]. Register data element availability is  
553 necessary but not sufficient; more research is required to explore whether register layout, column  
554 labelling and cell coding affect data quality. For example, facilities might consider excluding blank  
555 cells from their register design, as blank cells may indicate a health procedure either “not recorded”

556 (incomplete) or “not done”. Standardised register designs will require local ownership for  
557 adaptation, and testing of process, with considerable streamlining with other documentation, to  
558 reduce burden on frontline health workers. Research regarding improved register filling may focus  
559 on capability (capacity to engage in the register documentation), opportunity (factors that make the  
560 behaviour possible) and motivation (to energies and direct behaviour). Exploring flow of aggregated  
561 data from labour ward registers into HMIS is another gap requiring research regarding steps of  
562 aggregation. Several manual operations (e.g. manual counting, filling paper summary/tally forms,  
563 digital data entry) may reduce data quality significantly [65]. Finally, perspectives of data users  
564 beyond the patient-health worker-register interface are critical. Yet, to date, there has been little  
565 investment in improving routine register data quality to maximizing the potential of this underused  
566 and widely available data source around the time of birth.

## 567 **Conclusion**

568 With more than 80% of the world’s births in facilities, labour ward register data have an unrealised  
569 potential to track core indicators in facilities and higher up the health system. Our multi-country  
570 study found multiple opportunities to improve the data and the use of data: standardised design,  
571 consistent filling processes and enabling two-way feedback between different levels of the health  
572 system data pyramid. Overcoming these barriers would enable frontline health workers, especially  
573 midwives, to be valued for the register data they collect, to improve data quality and importantly to  
574 use those data to improve quality of care for the women and babies they care for.

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767

## 768 **ABBREVIATIONS**

769 **BD**, Bangladesh

770 **CeMNC**, Comprehensive emergency obstetric and newborn care

771 **CIFF**, Children’s Investment Fund Foundation

772 **DHS**, The Demographic and Health Survey Program

773 **DHIS2**, District Health Information Software 2

774 **ENAP**, *Every Newborn* Action Plan now branded as *Every Newborn*

775 **EN-BIRTH**, *Every Newborn-Birth Indicators Research Tracking in Hospitals* study

776 **FGD**, Focus Group Discussions

777 **HIV**, Human immunodeficiency virus

778 **HMIS**, Health Management Information Systems

779 **icddr,b**, International Centre for Diarrhoeal Disease Research, Bangladesh

780 **IDI**, In-depth interview

781 **LMIC**, Low-Middle Income Countries

782 **MICS**, Multiple Indicator Cluster Survey  
783 **NP**, Nepal  
784 **PRISM**, Performance of Routine Information System Management  
785 **TZ**, Tanzania  
786 **COREQ**, Consolidated criteria for reporting qualitative research

787

## 788 **DECLARATIONS**

### 789 [Ethics and consent to participate](#)

790 This study was granted ethical approval by institutional review boards in all operating counties in  
791 addition to the London School of Hygiene and Tropical Medicine (Additional file 17).

792 Voluntary informed written consent was obtained from all respondents for the qualitative  
793 interviews. Participants were assured of anonymity and confidentiality.

794 EN-BIRTH is study number 4833, registered at <https://www.researchregistry.com>

### 795 [Consent for Publication](#)

796 Not applicable

797

### 798 [Availability of data and material](#)

799 The datasets generated during and/or analysed during the current study are available on LSHTM  
800 Data Compass repository, <https://datacompass.lshtm.ac.uk/955/>.

801

### 802 [Competing interests](#)

803 The authors declare that they have no competing interests.

804

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811 analysis, data interpretation, report writing or decision to submit for publication. The corresponding  
812 author had full access to study data and final responsibility for publication submission decision.

813

814 **Authors' contributions**

815 The EN-BIRTH study was conceived by JEL, who acquired the funding and led the overall design with  
816 support from HR. For this paper, DS reviewed the literature with HR. LTD led the design of the tools  
817 and co-ordinated the multi-country group which was led by DS in Tanzania, SBZ in BD and AKS in NP.  
818 LTD and JEL conceptualised the framework. LTD summarised the registers with assistance from HR.  
819 DS and LTD led the qualitative analysis with assistance from SBZ and AKS. LTD and KP led the analysis  
820 of the care-documentation checklist with assistance from SBZ. LTD and DS designed the figures with  
821 KP. DS and LTD drafted the manuscript with inputs from SBZ and the multi-country group and JEL.  
822 Authors made substantial contributions to the conception, design, data collection or analysis or  
823 interpretation of data for the work including: icddr, Bangladesh: SBZ with RH, JK, MTUST, RH, TM,  
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826 the manuscript and gave final approval of the version to be published and agree to be accountable  
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832

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864 TABLES

865 *Table 1: Performance of routine information system management (PRISM) conceptual framework*  
 866 *components*

Type	Category	Content
<b>INPUTS</b> RHIS Determinants	<b>Technical Factors</b>	Complexity of reporting forms, procedures
		HIS design
		Computer Software
		Information technology complexity
	<b>Organisational Factors,</b>	Governance
		Planning
		Training
		Supervision
		Quality
		Finance
		Promotion of culture of information
		Availability of resources
	<b>Behavioural factors</b>	Level of knowledge of content of HIS forms
		Data quality checking skills
		Problem solving for HIS tasks
Competence in HIS tasks		
Confidence levels for HIS tasks		
Motivation		
Demand		
<b>PROCESS</b> steps	<b>RHIS processes</b>	Data collection
		Data transmission
		Data processing
		Data analysis
		Data quality check
		Feedback
<b>OUTPUT</b> desired	<b>Improved RHIS performance</b>	Data quality/information use
<b>OUTCOME</b> desired	<b>Improved Health System performance</b>	
<b>IMPACT</b> desired	<b>Improved health status</b>	Improved health status

867 **References:** PRISM framework and Monitoring framework for ending preventable maternal  
 868 mortality [23, 24].

869

Table 2: Ward routine register designs capturing selected newborn and maternal indicators, EN-BIRTH study

	BD - Azimpur Tertiary		BD - Kushtia District		NP - Pokhara Regional	TZ - Temeke Regional	TZ - Muhimbili National	
<b>Labour and Delivery Ward Register name</b>	Delivery register	EmONC register	Delivery register	EmONC register	Maternity Register	Delivery book	Delivery book	Perinatal research register
<b>Register format</b>	Original hospital	Revised national	Original hospital	Revised national	National	National	National	Additional research
<b>Number of data elements</b>	25	58	24	58	35	48	48	47
<b>Number of columns:</b>								
total	20	45	18	45	32	48	48	39
for uterotonics	1	1	1	1	0	2	2	2
for early breastfeeding	0	1	0	1	0	2	2	2
for neonatal resuscitation	0	1	0	1	0	1	1	1

Details regarding selected indicators in Additional file 10.

Note: register designs may record more than 1 data element per column



Table 3: Summary of research methods assessing barriers and enablers to labour ward register documentation, EN-BIRTH study

Method	Description of the method	Duty Ward	Responsibility	Selected indicator documented explored
<b>Heath workers:</b>				
<b>a) In-depth interviews and c) care-documentation checklist</b>	Nurses/midwives (n=3 per hospital, total n=15)	Labour and Delivery	Care for patient and document	<ul style="list-style-type: none"> <li>• Uterotonics to prevent PPH</li> <li>• Early initiation of breastfeeding</li> <li>• Neonatal bag mask ventilation</li> </ul>
	Doctors (n=1 per hospital, total n=5)	Labour and Delivery included	Care for patient and document	All selected indicators
<b>b) Focus Group Discussion</b>	Nurses/midwives from each ward (n=1 FGD per hospital, total n=5)	Labour and Delivery included	Care for patient and document	All selected indicators
<b>EN-BIRTH data collectors:</b>				
<b>a) In-depth interviews and c) care-documentation checklist</b>	Data Trackers (n=3-4 per hospital, total n=19)	Registered patient at start of study	Observed care process and some content of documentation	Not applicable
	Clinical observers (n=4-8 per hospital, total n=24)	All wards	Observed care process but not content of documentation	All selected indicators
	Data Verifier/Extractor (n=1-4 per hospital, total n=13)	All wards	Extracted data from registers and patient notes for EN-BIRTH study	All selected indicators
	Supervisors (n=1-2 per hospital, total n=9)	All wards	Observed process and extracted data from registers and patient notes	All selected indicators

Further details of respondents from all wards in Additional file 2.

## FIGURES

Figure 1: Barriers and enablers to routine recording of coverage indicators in labour ward registers, EN-BIRTH Study

## ADDITIONAL FILES

File Name	Format	Title of Data
Additional file 1	.pdf	<b>Error! Reference source not found.</b>
Additional file 2	.pdf	<i>Summary of qualitative research methods to assess barriers and enablers to labour/newborn ward register documentation, EN-BIRTH study</i>
Additional file 3	.pdf	<i>Health Worker study guides in-depth interview (IDI) focus group discussion (FGD), EN-BIRTH Study</i>
Additional file 4	.pdf	<b>Error! Reference source not found.</b>
Additional file 5	.pdf	<i>Codebook Health Workers, EN-BIRTH study</i>
Additional file 6	.pdf	<b>Error! Reference source not found.</b>
Additional file 7	.xlsx	<i>COREQ checklist, EN-BIRTH study</i>
Additional file 8	.pdf	<i>Care-to-documentation checklist, EN-BIRTH study</i>
Additional file 9	.pdf	<b>Error! Reference source not found.</b>
Additional file 10	.pdf	<i>Labour ward routine register column design for maternal and newborn indicators, EN-BIRTH study</i>
Additional file 11	.pdf	<b>Error! Reference source not found.</b>
Additional file 12	.pdf	<b>Error! Reference source not found.</b>
Additional file 13	.pdf	<i>Labour ward care/documentation responsibilities by intervention, research data collector respondents EN-BIRTH study</i> <b>Error! Reference source not found.</b>
Additional file 14	.pdf	<i>Labour ward register order within all documentation, by indicator - health worker respondents EN-BIRTH study</i> <b>Error! Reference source not found.</b>

Additional file 15	.pdf	<i>Labour ward register order within all documentation, by indicator - data collector respondents EN-BIRTH study</i> <b>Error! Reference source not found.</b>
Additional file 16	.pdf	<i>Estimated minutes between care and documentation by indicator, care-documentation checklist, EN-BIRTH study</i> <b>Error! Reference source not found.</b>
Additional file 17	.pdf	<b>Error! Reference source not found.</b>