

1 HYGIENE ALONG THE CONTINUUM OF CARE IN THE
2 EARLY POST-NATAL PERIOD: AN OBSERVATIONAL
3 STUDY IN NIGERIA

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16

17 ABSTRACT

18 **Background:** Newborns delivered in healthcare facilities in low- and middle-income countries are at an
19 increased risk of healthcare associated infections. Facility-based studies have focused primarily on
20 healthcare worker behaviour during labour & delivery with limited attention to hygiene practices in
21 post-natal care areas and largely ignore the wide variety of actors involved in maternal and neonatal
22 care.

23 **Methods:** This exploratory mixed-methods study took place in six healthcare facilities in Nigeria where
24 31 structured observations were completed during post-natal care, discharge, and the first six hours
25 after return to the home. Frequency of hand hygiene opportunities and hand hygiene actions were
26 assessed for types of patient care (maternal and newborn care) and the role individuals played in
27 caregiving (healthcare workers, cleaners, non-maternal caregivers). Qualitative interviews with
28 mothers were completed approximately 1 week after facility discharge.

29 **Results:** Maternal and newborn care were performed by a range of actors including healthcare workers,
30 mothers, cleaners and non-maternal caregivers. Of 291 hand hygiene opportunities observed at health
31 facilities, and 459 observed in home environments, adequate hand hygiene actions were observed
32 during only 1% of all hand hygiene opportunities. Adequate hand hygiene prior to cord contact was
33 observed in only 6% (1/17) of cord contact related hand hygiene opportunities at healthcare facilities
34 and 7% (2/29) in households. Discharge advice was infrequent and not standardised and could not be
35 remembered by the mother after a week. Mothers reported discomfort around telling non-maternal
36 caregivers to practice adequate hand hygiene for their newborn.

37 **Conclusions:** In this setting, hand hygiene practices during post-natal care and the first six hours in the
38 home environment were consistently inadequate. Effective strategies are needed to promote safe hand
39 hygiene practices within the post-natal care ward and home in low resource, high-burden settings. Such
40 strategies need to target not just mothers and healthcare workers but also other caregivers.

41 **Keywords:** hand hygiene; healthcare associated infections; post-natal; neonatal infection; infection
42 prevention and control; newborn care; Nigeria; maternal infection

43

44 BACKGROUND

45 In populations with a high burden of neonatal mortality, up to half of all neonatal deaths are caused by
46 infections, many of which are transmitted at the time of childbirth (1, 2). Facility-based births are
47 essential to providing safe, quality healthcare to mothers and newborns at the time of childbirth.
48 However, newborns born in healthcare facilities (HCF) in low- and middle-income countries (LMIC) are
49 at an increased risk of early onset sepsis due to unhygienic care practices during childbirth and post-
50 natal care (3, 4). Estimates suggest that newborns delivered in HCF in LMIC have 3-20 times greater risk
51 of healthcare associated infections (HCAI) compared to newborns delivered in facilities in high income
52 countries (3, 5). However, this gap is likely to widen, with increasing proportions of women in LMIC
53 giving birth at HCFs lacking robust infection prevention and control and hygiene management practices
54 (1, 5-8).

55 Hand hygiene practices are an essential component of infection prevention and control (IPC) strategies
56 in newborn and maternal care (9-11). Improved handwashing practices by birth attendants and
57 mothers have been associated with a 19% and 44% reduction in neonatal mortality, respectively (9).
58 To promote adequate hand hygiene in healthcare settings globally, the World Health Organisation
59 (WHO) has published hand hygiene guidelines for healthcare workers (HCW) on key moments for hand
60 hygiene during patient care (12-14). Hand hygiene is also included as part of WHO recommended
61 essential practices during newborn care - specifically before and after handling the newborn, before
62 and after cord care, and after diaper changing (15).

63 Many HCF-based studies on hand hygiene practices during maternal and newborn care in LMIC have
64 focused on HCW hand hygiene during labour and delivery or high-risk environments such as the
65 neonatal intensive care units (16-20). Community-based studies have generally focused on caregiver
66 hygiene practices for newborns who are born outside the health facility or during the late post-natal
67 period (>7 days after birth) (18, 21-25). Limited attention has been given to understanding hand

68 hygiene compliance by the wide range of personnel and caregivers providing facility- and home-based
69 newborn care in the immediate and early post-natal period (<8 days after birth) (26, 27).~~(28)~~.
70 Understanding hand hygiene practices of various caregivers during this early post-natal period and how
71 these are influenced by multiple factors allows for the design and implementation of more effective
72 facility-based interventions to improve behaviours. The objective of this study is to document observed
73 hand hygiene practices during the early post-natal care period in the healthcare facility and the first six
74 hours after returning home.

75 METHODS

76 *STUDY DESIGN*

77 The data presented here were collected over 4 weeks in July 2017 as part of a larger mixed-methods
78 study investigating hygiene practices during childbirth, post-natal care, and return to the home
79 environment across six health facilities in Kogi and Ebonyi states. Data reported here focus on the post-
80 natal care ward, facility discharge, and the home environment. Findings related to IPC standards and
81 infrastructure and practices during labour and delivery have been reported elsewhere (29, 30).

82 Facilities sampled for this study were all participating in the Maternal and Child Survival Program (MCSP)
83 quality of care improvement program funded by the United States Agency for International
84 Development (USAID). While all participating facilities received interventions aimed at improving the
85 quality and utilisation of maternal and neonatal healthcare services, focus on hygiene was very limited.
86 Further details of the MCSP quality of care improvement programme and facility selection are described
87 in previous publications (29, 30). In both Kogi and Ebonyi states, we sampled one facility at each of
88 three levels: one primary HCF, a secondary HCF, and a tertiary HCF.

89 *DATA COLLECTION*

90 Facility-level data collection has been previously described (29, 30). In brief, a structured facility
91 observational checklist and a needs assessment survey were completed on the first day of observation
92 in each participating HCF.

93 **Structured Observations**

94 Structured observations were completed during childbirth, post-natal care, discharge, and the first six
95 hours after returning home. A total of 39 women were recruited across the six facilities for at least one
96 observation period. As a descriptive exploratory study, sample size was based primarily on resources
97 availability. Participant eligibility criteria and observations of hand hygiene during childbirth have been
98 previously reported (29). Post-natal care observations began when the mother and baby were moved
99 from the delivery area to the maternity/post-natal ward, hereafter referred to as post-natal care ward.
100 Data collection staff documented observed hygiene practices and actions of all individuals involved in
101 any maternal and newborn care for a period of up to four continuous hours or until the mother was
102 discharged.

103 At the time of discharge, data collection staff directly observed and documented the discharge process
104 with emphasis on recording discharge instructions the new mother received, particularly any reference
105 to hygiene, handwashing and cord care. After discharge, staff accompanied the woman and newborn
106 to her home to observe the hand hygiene practices there. Home observations lasted from the time of
107 arrival in the home for up to six hours. At the home, key observations included newborn care practices
108 (breastfeeding, bathing, diaper changes and handling), hand hygiene practices of all individuals involved
109 in any newborn care, and other standard hand hygiene opportunities (feeding of self or others, visiting
110 toilet, food preparation). At the end of the home observation, a structured spot check was completed
111 of the home environment to assess the presence and availability of water, sanitation, and hygiene
112 facilities in the home.

113

114 Semi Structured Interviews

115 The questionnaire used, data collection methods and analysis for these interviews have been previously
116 published (30). Semi-structured interviews were completed with one facility head, nurse or midwife,
117 cleaner and mother per participating facility for a total of 18 HCF staff and 6 mothers. Mothers who
118 consented to a second home visit had their phone numbers recorded at the end of the home
119 observation. On the fifth day following the home visit, a selected mother was called to arrange the 45-
120 minute interview, which was then conducted in person at her home, at least seven days after the initial
121 home visit. All household interviews were audio recorded and conducted in Yoruba, Igbo or English in
122 two teams of two female local enumerators (an interviewer and a note taker), with prior experience of
123 conducting qualitative research.

124

125 DATA ANALYSIS

126 All quantitative data were analysed using StataSE 15 (Stata Corp, College Station, TX, USA). Data from
127 the facility needs assessment and walk through tools were examined descriptively to provide context
128 for structured observation findings. Qualitative notes recorded during the observation data collection
129 were reviewed and where applicable, recoded using STATA.

130 Observation data analysis was descriptive and focused on frequency and sequence of hand hygiene
131 opportunities and associated hand hygiene actions based on WHO's Five Moments for Hand hygiene
132 and the three moments adapted for community neonatal hand hygiene (31, 32). ~~(33)~~. For the purposes
133 of analysis, hand hygiene "opportunities" were defined as any activity that put hands at potential risk
134 of contamination or activities that resulted in possible transmission of infectious agents to the mother
135 and/or newborn during the observed period. Hand hygiene opportunities related to maternal care
136 included: conducting clinical procedures on mothers (intramuscular injections, intravenous (IV)

137 procedures), changing of perineal pads and emptying urine pots. Hand hygiene opportunities related
138 to newborn care included direct cord contact via cord cleaning or cord inspection as well as activities
139 during newborn care that could result in unobserved cord contact such as changing nappies, changing
140 the newborn's clothes, and skin contact with the newborn's body. Hand hygiene "actions" were defined
141 as any action taken in response, proactively or reactively, to a hygiene opportunity in an effort to
142 mitigate potential infection transmission. Observed hand hygiene actions associated with each hand
143 hygiene opportunity were coded into three categories in analysis. First, *no action* or *action* was assigned
144 to any hand hygiene opportunity when there was no observed hand hygiene action taken or action
145 taken. Hand hygiene actions were further coded as *adequate* (handwashing with soap and water) or
146 *inadequate* (wearing gloves without handwashing with soap or rinsing with water only).

147 A variety of individuals were observed taking part in maternal and newborn care; we refer to these
148 individuals as actors in our analysis. At the HCF, actors were categorised into five groups: mothers,
149 fathers, HCW (doctors, nurses and midwives), cleaners (employed by the HCF), and *visitors* – all
150 individuals not employed by the HCF and not the child's mother or father. At the home, actors were
151 categorised into three groups in analysis: mothers, fathers and non-parental caregivers. Non-parental
152 caregivers included all other individuals who were observed engaging in the newborn caregiving
153 activities at the home and included household members, relatives, and other non-family visitors. Our
154 analysis explored the frequency of hand hygiene opportunities and hand hygiene actions by type of
155 actor (mothers, fathers, HCW, visitors, cleaners and non-parental caregivers), by patient care setting
156 (HCF and home) and type of care provided (maternal and newborn care).

157 Qualitative data was transcribed into Microsoft Word (Redmond, Washington) and analysed in
158 Microsoft Word and Excel (Redmond, Washington). Findings from HCF staff interviews around IPC
159 related practices have been previously reported (30); qualitative data reported here focus on responses
160 around discharge information and newborn care in the home environment.

161 Any self-reported practices by the mothers were compared against structured observations results.
162 Interview and field note transcripts were coded by one author and independently reviewed by another
163 (30). Thematic analysis was deductive, based on the hand hygiene moments for community newborn
164 care (32) specifically; during newborn handling - before carrying or after bottom cleaning following
165 defecation, and cord care/contact.

166 RESULTS

167 *PARTICIPANT INFORMATION*

168 A total of 39 mothers were recruited across the six facilities for at least one observation period; 31
169 mothers during labour and delivery, 31 mothers during post-natal period at the HCF, and 30 mothers
170 at home. Eight mothers dropped out of the study after the post-natal care observations due to
171 observation fatigue or non-consenting household members. An additional 7 participants were
172 recruited for facility discharge and home observations.

173 Mothers had similar characteristics across the observations and interviews. (Table 1). All participating
174 mothers reported they were married with a mean age of 30 (range: 19 – 39), had 2 previous births
175 (range: 0 – 6) and spent an average of 35 minutes travelling to the health care facility (range: 5 – 120).
176 Fathers were present in 26/31 post-natal care observations and in 28/30 home observations.

177 **[TABLE 1]**

178 POSTNATAL CARE

179

180 *WATER, SANITATION, AND HYGIENE FACILITIES*

181 Functioning handwashing facilities with soap were available in 2 of the 6 post-natal care wards;
182 however, no material for hand drying was present. There was no other provision for handwashing
183 within any of the post-natal care wards e.g. alcohol-based hand rub.

184 *HAND HYGIENE OPPORTUNITIES AND ACTION*

185 A total of 291 hand hygiene opportunities were observed during the post-natal period, 27% related to
186 maternal care (79/291) and 73% related to newborn care (212/291) (Table ~~1~~-~~2~~).

187 **[TABLE ~~1~~-~~2~~]**

188 Visitors accounted for 37% (103/291) of all observed hand hygiene opportunities. The majority (95%)
189 of visitors' hand hygiene opportunities were during newborn care activities. The remaining observed
190 hand hygiene opportunities were among HCW (29%), mothers (21%), fathers (13%) and cleaners (2%).

191 Across all actors, no hand hygiene action was observed in relation to 91% (265/291) of hand hygiene
192 opportunities. Half (13/26) of all observed hand hygiene actions were by HCW and the other half
193 (13/26) by mothers. No hand hygiene actions were conducted by fathers, visitors, or cleaners. Only 3
194 of 26 hand hygiene actions observed were categorized as *adequate* (handwashing with soap and water)
195 - once by a HCW prior to inspecting a mother's perineal stitches -and twice by mothers; prior to cord
196 cleaning and prior to carrying the newborn. The remaining 23 hand hygiene actions were *inadequate*,
197 and included HCWs wearing gloves without washing hands with soap prior to glove use (12/26) and
198 mothers rinsing hands with water only (11/26). Among HCW, half (6/12) of inadequate hand hygiene
199 actions were during maternal care - mostly prior to IV related procedures including cannula insertion,
200 changing IV therapy bags and inspecting the IV cannula site. Of the 212 hand hygiene opportunities
201 observed during newborn care, 8% (17/212) were related to cord contact and the rest (195/212), were
202 during other contact with the newborn (Table ~~2~~-~~3~~).

203 **[TABLE ~~2~~-~~3~~]**

204 Cord contact in the post-natal care ward was made by multiple actors - mothers, HCWs, cleaners and
205 visitors. The majority (13/17) of cord contact hand hygiene opportunities happened prior to cord
206 cleaning and the rest (4/17) were during umbilical cord stump inspections. Across the 17 cord contact
207 hand hygiene opportunities observed, hand hygiene actions were conducted 5 times, all of which were
208 prior to cleaning of the newborn's cord. Only 1/5 of hand hygiene actions was adequately performed.

209 DISCHARGE

210

211 The average length of stay after birth across all six facilities was 35 hours (range: 7 – 96 hours).
212 Standardized discharge procedures were reported in all but one HCF. Key informants reported that
213 discharge procedures included specific health information that should be provided to mothers at the
214 time of discharge. However, 9/33 mothers did not receive any discharge advice at all from the midwives
215 (Table [3](#)–[4](#)).

216 [TABLE [3](#)–[4](#)]

217 When given, discharge advice covered both maternal and newborn care. Information on hand hygiene,
218 typically related to newborn care; specifically cord care, baby handling and breastfeeding. During
219 observations, approximately half (17/33) of mothers received advice on washing their hands before
220 handling the baby and 70% (23/33) received information on clean cord care, including washing hands
221 before and after applying chlorohexidine, applying chlorohexidine exclusively on the cord, and placing
222 the cord outside the diapers. However, in follow-up qualitative interviews, the only hand hygiene
223 related discharge information that mothers could recall was involving breast feeding practices.

224 *... First and foremost, I was told that it is not good for a breastfeeding mother to keep long*
225 *nails, that it harbours dirt and that it is dangerous to the baby. Secondly, I must wash my hands*
226 *before I breastfeed the baby. In fact, I must make sure that the environment where the baby*
227 *stays is very clean. – Mother, tertiary facility*

228

229 HOME OBSERVATIONS

230

231 The average duration of home observations was 5.1 hours (range: 2.4 – 6.8 hours) with an average of
232 101 hand hygiene opportunities recorded per observation (range: 30 – 180). Home observations
233 started an average of 4 hrs after discharge from the facility (range: 0 – 21). Three out of thirty women
234 where observed more than six hours post discharge.

235 WATER SANITATION AND HYGIENE FACILITIES

236 Half (16/30) of households had access to a water source within the home, 7 had access to an on plot
237 water source, and 7 used a public shared water source. The majority (27/30) of households had stored
238 water within their household at the time of the observation, and all but one (29/30) had soap at the
239 household. Of the 30 households visited, 21 had a private latrine, 8 had access to a latrine shared with
240 other households, and 1 did not have access to a latrine. Two-thirds of households (20/30) had a
241 handwashing facility within the compound, but only 9 households with a handwashing facility had soap
242 or another cleansing agent present at the site. There was an average of 15 non-parental caregivers
243 observed across household observations (range: 3 - 39). Non-parental caregivers included household
244 members, visiting relatives, and other visitors.

245 **HAND HYGIENE: OPPORTUNITIES AND ACTION**

246 All interviewed mothers knew both when and how hands should be washed in the home environment:

247 *Before carrying my baby, I wash my hand, before carrying her and anytime I go to the toilet, I*
248 *wash my hand before carrying my baby, even if I go to the kitchen to cook, I wash my hand even*
249 *if I just go to urinate I wash my hand before carrying my baby. – Mother, secondary facility*

250 *When I want to take care of the cord, I will wash my hand because I will be bathing the baby. I*
251 *will wash my hand before I carry the baby for bathing. – Mother, primary facility*

252 However, this knowledge was not reflected in practice. In only 1% (5/459) of all hand hygiene
253 opportunities observed in the home environment was hand hygiene performed adequately and fthe
254 459 hand hygiene opportunities observed in the home environment, only 1% (5/459) was followed with

255 ~~adequate hand hygiene action and~~ hands were rinsed at another 3% (12/459) of hand hygiene
256 opportunities (Table [4](#), [5](#)). Mothers conducted the majority (15/17) of the hand hygiene actions.

257 **[TABLE 4]5**

258 Cord contact accounted for 6% (29/459) of all hand hygiene opportunities; the majority (22/29) related
259 to cord cleaning. Adequate hand hygiene was observed during 2 of 29 cord contact-related hand
260 hygiene opportunities.

261 Non-maternal caregivers performed a variety of activities in the household, many of which put them at
262 potential risk of transmitting infections to newborns during caregiving **[see Additional File 1]**. Over half
263 of newborns (19/30) were bathed within the first six hours of their arrival to the home and bathing
264 often involved multiple non-maternal caregivers. In one household, a newborn was bathed by 6
265 different non-maternal caregivers during the observation period. Following bathing, 8/19 newborns
266 were rubbed with oils, in some cases mixed with different substances including; cassava flour mixed in
267 red oil; black soap; palm kernel oil; shea butter; garlic and raw egg.

268 Despite the clear role of non-maternal caregivers in newborn care, mothers reported that asking any
269 caregivers beyond fathers to wash hands was not feasible. Mothers noted that the caregivers would
270 *'not be happy'* or that they would *'become angry'* if they were asked to wash their hands:

271 *Some visitors are in a haste, when they come they do not wash their hand, they carry their baby,*
272 *after they go – [if asked to wash hands] they will become angry. - **Mother secondary facility***

273 *I can't tell visitors like that! - **Mother, tertiary facility***

274 Some mothers, however described strategies for protecting their newborn, mostly by using the baby
275 wrap as a physical barrier between the skin and the non-parental caregivers' contaminated hands.

276 *If I ask them to wash their hands, I don't know what they will feel! That is why I cover my baby*
277 *with a towel before they carry my baby - **Mother, primary facility***

278 *He is already dressed and covered with a towel so their hand will not touch the baby's skin -*
279 **Mother, primary facility**

280 DISCUSSION

281 Our mixed methods exploratory study describes hand hygiene practices in the post-natal care ward,
282 facility discharge and the home environment across six healthcare facilities in Nigeria. Our findings show
283 a low prevalence of hand hygiene practice during post-natal care and in the home environment in the
284 immediate post-birth period. Our study also provides data on the wide range of individuals who are
285 involved in both maternal and newborn care along this continuum, including healthcare workers,
286 cleaners, visitors, fathers, mothers, and non-parental caregivers. Not only were hand hygiene actions
287 rare during our observation period, similarly to other studies, hand hygiene actions were largely
288 inadequate; for example, HCW using gloves without having washed their hands with soap before (29,
289 34) and mothers and other caregivers rinsing hands with water only (21, 22, 35, 36). Visitors in the
290 health facility and non-maternal caregivers at the home accounted for the majority of observed hand
291 hygiene opportunities, particularly around newborn care, but no hand hygiene actions were observed
292 by these groups.

293 Handwashing with soap promotion will fail if inadequate infrastructure is in place. Unlike the labour
294 and delivery rooms for facilities included in this study (30) the vast majority of post-natal care wards
295 lacked adequate hand hygiene infrastructure and/or supplies. The lack of functioning hygiene
296 infrastructure and supplies is commonly reported as a major barrier in both HCFs and at home to
297 practicing hygienic behaviours (37-39). The provision of handwashing facilities with soap at all points of
298 care are the basic requirements for HCFs according to global monitoring strategies (40). Point of care
299 can be recognised as the place where the patient, the HCW, and the provision of care or treatment
300 come together (12). ~~(41)~~. Our study shows that in the context of newborn care in the HCF, the 'point
301 of care' should expand beyond delivery ward and include post-natal care areas. In the absence of
302 hygiene infrastructure, alcohol-based hand rubs have been shown to improve hand hygiene practices
303 and may be an effective low cost intervention for consideration (42-46).

304 The prevalence of appropriate hand hygiene by HCW during labour and delivery has been found to be
305 generally low (17, 29, 34, 47). This study finds that HCW maintain inadequate hand hygiene practices
306 into the post-natal care period. Increased emphasis on HCW washing hands with soap and appropriate
307 glove use in post-natal care is needed and should be incorporated into standard quality of care and IPC
308 improvement programs. Previous data from participating facilities shows that current models of step-
309 down training on hand hygiene and IPC are inadequate, didactic, irregularly given and accompanied by
310 little to no oversight (30). In addition to general improvements to the overall infection control and hand
311 hygiene training (44, 48-50), our data suggest that adherence to hand hygiene protocols specific to the
312 post-natal care areas should be emphasised and integrated into multi-modal infection control
313 strategies (44, 50).

314 The discharge process presents a valuable but under-utilised opportunity to promote hand hygiene
315 among all caregivers along the care continuum from facility to the home. Another study in Edo state,
316 Nigeria found that mothers who practiced hygienic cord care reported that nurses had a stronger
317 influence on mothers' behaviours compared to other caregivers (51). Together with standardised
318 discharge protocols and checklists (52), additional moments in the post-natal ward need to be identified
319 to enable HCWs to provide and reinforce accurate, standardised, and simplified information in a way
320 that it can be remembered and practiced by all caregivers while in the post-natal ward and at home.

321 Our observational study demonstrates the important role that non-maternal caregivers play during care
322 both in the post-natal care ward and in the home environment. Other facility based studies in LMIC
323 have documented the integral role of family members in patient management, their accompanying
324 hand hygiene practices and the potential exposure risk they carry. For example, studies in Bangladesh
325 reported that compliance of family members providing inpatient care ranged between 0% (53) and 3%
326 (36). Studies on hygiene during neonatal care in the home environment focus primarily on the new
327 mothers or birth attendants (18, 23, 24, 54). Non-maternal caregivers are not only actively engaged in
328 newborn care in these settings, but they are also important drivers of the mothers' handwashing

329 behaviours (21, 22). Interventions may potentially overlook the critical role and engagement of fathers
330 and extended family members in newborn contact (55). In a tertiary hospital in India, Biswal et al. (56)
331 reported a 13% improvement of family member compliance following the implementation of a hand
332 hygiene improvement strategy that included a caregiver-specific training component. Understanding
333 the drivers of behaviours of the wider context within which the mother exists and how these behaviours
334 are informed and modified by both the physical and social environment can help in the development
335 of new interventions that target wider audiences in both the home and the healthcare (53, 55, 57).

336 The small number of facilities for this observational study limit the generalisability of our findings to
337 beyond these study sites. Our study had a participant dropout rate of 26% prior to the home
338 observations, which may have introduced bias into our study if the participants who dropped out
339 systematically differed from those who remained or were later recruited into the study. However, data
340 suggests that drop-outs and new enrolments were similar in age, previous births, and time spent
341 travelling to clinic. Reactivity by participants to the presence of an observer may have led some actors
342 to increase hand hygiene compliance (58). However, this reactivity was minimised by avoiding any
343 explicit mention of handwashing behaviour being the aim of the study and carrying out the observations
344 before the household interviews and overall low levels of hand hygiene compliance observed in this
345 study suggest that the impact of reactivity on handwashing behaviours was likely minimal.

346 CONCLUSION

347 Our study shows that hand hygiene along the entire continuum of maternal and newborn care is
348 inadequate. ~~and requires targeted interventions for both maternal and newborn well-being.~~ In addition
349 to the delivery room, future behaviour change interventions need to address hand hygiene practices
350 within the post-natal care ward and early days at home and target a wider range of caregivers than
351 mothers and healthcare workers. More in-depth research is required to understand the drivers of hand
352 hygiene practices for all actors involved in maternal and newborn care in the immediate post-birth

353 period and targeted interventions needed to improve hand hygiene practices developed. However, the
354 basic provision of appropriate hygiene infrastructure in post-natal care wards is an urgent action that
355 should prioritized as part of global efforts to expand water, sanitation, and hygiene coverage in
356 healthcare facilities.

357 LIST OF ABBREVIATIONS

358 HCAI – Healthcare associated infections

359 HCF- Healthcare facilities

360 HCW - Healthcare workers

361 IPC - Infection prevention and control

362 IV - Intravenous

363 LMIC – Low- and middle-income countries

364 WHO - World Health Organisation

365 Declarations

366 ***Ethics approval and consent to participate:*** Ethics approvals were granted by the Institutional Review
367 Board at London School of Hygiene and Tropical Medicine (Ref: 13643), and the ethical review boards
368 of Kogi state (Ref: MOH/KGS/1376/1/84) and Ebonyi state (Ref: SMOH/ERC/33/017). All participants
369 provided written informed consent prior to participation. Mothers were only approached and
370 enrolled prior to entering the second stage of labour. Women below the age of 18 years and/or with
371 pre-existing conditions associated with a high-risk pregnancy and/or birth complications were
372 excluded from the study.

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Table 1: Participant information

	Post-natal care observations	Home observations
	(n = 31)	(n = 30)
	Mean (range)	Mean (range)
Age	30 (22—38)	30 (19—39)
Number of previous live births	2 (0—6)	2 (0—5)
Time spent traveling to clinic (minutes)	36 (10—120)	33 (5—80)

Table 1: 2: Observed hand hygiene opportunities and actions within post-natal care ward

	Hand Hygiene Opportunities		Hand hygiene actions		
	n	<i>Adequate</i> ¹	n (%)		
			<i>Inadequate</i> ²	<i>No Action</i>	
<u>All observations</u>					
Mothers	61	2 (3)	11 (18)	48 (79)	
Fathers	37	0 (0)	0 (0)	37 (0)	
Healthcare workers	84	1 (1)	12 (14)	71 (84)	
Cleaners	6	0 (0)	0 (0)	6 (100)	
Visitors	103	0 (0)	0 (0)	103 (100)	
Total	291	3 (1)	23 (8)	265 (91)	
<u>Maternal Care</u>³					
Mothers	16	0 (0)	3 (19)	13 (81)	
Fathers	0	0 (0)	0 (0)	0 (0)	
Healthcare workers	57	1 (2)	6 (10)	50 (88)	
Cleaners	1	0 (0)	0 (0)	1 (100)	
Visitors	5	0 (0)	0 (0)	5 (100)	
Total	79	1 (1)	9 (12)	69 (87)	
<u>Newborn Care</u>⁴					
Mothers	45	2 (4)	8 (18)	35 (78)	
Fathers	37	0 (0)	0 (0)	37 (100)	
Healthcare workers	27	0 (0)	6 (22)	21 (78)	
Cleaners	5	0 (0)	0 (0)	5 (100)	
Visitors	98	0 (0)	0 (0)	98 (100)	

Total	212	2 (1)	14 (7)	196 (92)
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1. *Adequate hand hygiene action includes washing hands with soap and washing hands with soap and wearing clean gloves for aseptic procedures*
2. *Inadequate hand hygiene action includes rinsing hands without using soap or wearing gloves for aseptic procedures without handwashing with soap prior to donning gloves*
3. *Maternal care includes contact by the healthcare workers, intramuscular injections, IV-related procedures, changing perineal pads, and emptying urine pan*
4. *Newborn care includes direct cord contact via cord cleaning or cord inspection and newborn handling (changing newborn's diapers, cleaning newborns bottom following defecation, picking up and putting newborn down, rubbing newborn's body with body oils and powders, cleaning newborn's eyes, changing newborn's clothes, drying newborn with cloth, wiping newborn's face)*

Table 2.3: Observed hand hygiene opportunities and hand hygiene actions related to newborn care in post-natal care wards

	Hand Hygiene		Hand hygiene actions		
	Opportunities		n (%)		
	n	<i>Adequate</i> ¹	<i>Inadequate</i> ²	<i>No Action</i>	
<u>All observations</u>					
Mothers	45	2 (4)	8 (18)	35 (78)	
Fathers	37	0 (0)	0 (0)	37 (100)	
Healthcare workers	27	0 (0)	6 (22)	21 (78)	
Cleaners	5	0 (0)	0 (0)	5 (100)	
Visitors	98	0 (0)	0 (0)	98 (100)	
Total	212	2 (1)	14 (7)	196 (92)	
<u>Cord contact</u>³					
Mothers	7	1 (14)	0 (0)	6 (86)	
Fathers	0	0 (0)	0 (0)	0 (0)	
Healthcare workers	7	0 (0)	4 (57)	3 (43)	
Cleaners	1	0 (0)	0 (0)	1 (100)	
Visitors	2	0 (0)	0 (0)	2 (100)	
Total	17	1 (6)	4 (24)	12 (70)	
<u>Other newborn care</u>⁴					
Mothers	38	1 (3)	8 (21)	29 (76)	
Fathers	37	0 (0)	0 (0)	37 (100)	
Healthcare workers	20	0 (0)	2 (10)	18 (90)	
Cleaners	4	0 (0)	0 (0)	4 (100)	
Visitors	96	0 (0)	0 (0)	96 133 (100)	

Total	195	1 (1)	10 (5)	184 (94)
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1. *Adequate hand hygiene action includes washing hands with soap and washing hands with soap and wearing clean gloves for aseptic procedures*
2. *Inadequate hand hygiene action includes rinsing hands without using soap or wearing gloves for aseptic procedures without handwashing with soap prior to donning gloves*
3. *Cord contact includes direct cord contact via cord cleaning or cord inspection*
4. *Other newborn care includes newborn handling outside cord care (changing newborn's diapers, cleaning newborns bottom following defecation, picking up and putting newborn down, rubbing newborn's body with body oils and powders, cleaning newborn's eyes, changing newborn's clothes, drying newborn with cloth, wiping newborn's face)*

Table 3: 4: Observed Discharge advice given to mothers

Topic	Advice	Primary (N = <u>106</u>)	Secondary (N = 10)	Tertiary (N = <u>138</u>)
Mother care	Do not insert anything into the vagina	2	5	8
	Take rest and sleep	5	8	8
	Wash perineum daily and after faecal excretion	5	6	8
	Change sanitary pads every 4 to 6 hours	5	7	8
	Wash used pads or dispose of them safely	4	4	8
	Wash the body daily.	5	9	8
	Avoid sexual intercourse until the perineum heals	3	5	5
Newborn care	Wash hands before handling baby	3	6	8
	How to care for the cord	6	9	8
	Sleep under an insecticide treated net	6	6	8
	Exclusive breastfeeding	6	7	8
Other	Other advice	4	7	4
	No advice	4	0	5
Drugs	Pain relief	9	9	12
	Antiseptic	2	7	7
	Vitamin C	8	8	9
	Vitamin B complex	8	9	5

Table 4.5: Observed hand hygiene opportunities and hand hygiene actions in the household

	Hand Hygiene Opportunities		Hand hygiene actions		
	n	Adequate ¹	n (%)		
			Inadequate ²	No Action	
<u>All observations</u>					
Mothers	154	4 (3)	11 (7)	139 (90)	
Fathers	7	0 (0)	0 (0)	7 (100)	
Non-parental caregivers	298	1 (0.5)	1 (0.5)	296 (99)	
Total	459	5 (1)	12 (3)	442 (96)	
<u>Cord contact³</u>					
Mothers	16	2 (13)	1 (6)	13 (81)	
Fathers	0	0 (0)	0 (0)	0 (0)	
Non-parental caregivers	13	0 (0)	0 (0)	13 (100)	
Total	29	2 (7)	1 (3)	26 (90)	
<u>Other newborn care⁴</u>					
Mothers	138	2 (2)	10 (7)	126 (91)	
Fathers	7	0 (0)	0 (0)	7 (100)	
Non-parental caregivers	285	1 (0.5)	1 (0.5)	283 (99)	
Total	430	3 (1)	11 (3)	416 (96)	

1. Adequate hand hygiene action includes washing hands with soap and wearing clean gloves for aseptic procedures
2. Inadequate hand hygiene action includes rinsing hands without using soap or wearing gloves for aseptic procedures without handwashing with soap prior to donning gloves
3. Cord contact includes direct cord contact via cord cleaning or cord inspection
4. Other newborn care includes newborn handling outside cord care (changing newborn's diapers, cleaning newborns bottom following defecation, picking up and putting newborn down, rubbing newborn's body with body oils and powders, cleaning newborn's eyes, changing newborn's clothes, drying newborn with cloth, wiping newborn's face)

