

## Online Supplementary Document

Munos et al. Linking household survey and health facility data for effective coverage measures: a comparison of ecological and individual linking methods using the Multiple Indicator Cluster Survey in Côte d'Ivoire

J Glob Health 2018;8:020803

Supplemental Table S1: Components of structural quality indices, by service type

	Antenatal	L&D	Newborn	Postnatal	Sick Child
<b>Service availability</b>		<ul style="list-style-type: none"> <li>• L&amp;D antibiotic administration</li> <li>• L&amp;D function oxytocic for hemorrhage</li> <li>• L&amp;D anticonvulsants</li> <li>• L&amp;D assisted vaginal delivery</li> <li>• L&amp;D manual removal of placenta</li> <li>• L&amp;D removal of retained products</li> <li>• L&amp;D routine practice of Oxytocin for hemorrhage</li> <li>• L&amp;D partographs</li> </ul>	<ul style="list-style-type: none"> <li>• NB breastfeeding</li> <li>• NB cord care</li> <li>• NB thermal protection</li> <li>• NB neonatal resuscitation</li> <li>• NB KMC for LBW babies</li> </ul>	<ul style="list-style-type: none"> <li>• Inpatient</li> <li>• 24-hour staff coverage</li> <li>• FP counseling</li> <li>• Counseling on ITNs</li> <li>• Breastfeeding counseling</li> <li>• Newborn cares counseling</li> <li>• HIV preventive counseling</li> <li>• HIV test counseling</li> <li>• HIV test</li> <li>• ARV to mother</li> <li>• ARV to infant</li> </ul>	<ul style="list-style-type: none"> <li>• General curative care for malaria, ARI, diarrhea</li> <li>• IMCI services</li> <li>• Diagnosis and treatment of malnutrition</li> </ul>
<b>Commodities (drugs, equipment, supplies)</b>	<ul style="list-style-type: none"> <li>• ANC dip stick urine protein</li> <li>• ANC dip stick urine glucose</li> </ul>	<ul style="list-style-type: none"> <li>• L&amp;D ambulance</li> <li>• L&amp;D examination light</li> <li>• L&amp;D delivery pack</li> <li>• L&amp;D suction apparatus</li> <li>• L&amp;D manual vacuum extractor</li> </ul>	<ul style="list-style-type: none"> <li>• NB antibiotics for preterm</li> <li>• NB corticosteroids</li> <li>• NB injectable antibiotics</li> </ul>	<ul style="list-style-type: none"> <li>• Emergency transportation</li> <li>• Injectable antibiotics</li> </ul>	<ul style="list-style-type: none"> <li>• Cotrimoxazole or amoxicillin</li> <li>• ACTs</li> <li>• ORS</li> <li>• Zinc</li> </ul>

	<ul style="list-style-type: none"> <li>• ANC urine pregnancy test</li> <li>• ANC iron/folic acid</li> <li>• ANC tetanus toxoid vaccine</li> <li>• ANC IPT drug</li> </ul>	<ul style="list-style-type: none"> <li>• L&amp;D vacuum aspirator or D&amp;C kit</li> <li>• L&amp;D neonatal bag and mask</li> <li>• L&amp;D delivery bed</li> <li>• L&amp;D blank partographs</li> <li>• L&amp;D disposable gloves</li> <li>• L&amp;D infant weighing scale</li> <li>• L&amp;D blood pressure apparatus</li> <li>• L&amp;D soap/hand rub</li> <li>• L&amp;D eye ointment</li> <li>• L&amp;D injectable uterotonic</li> <li>• L&amp;D injectable antibiotics</li> <li>• L&amp;D magnesium sulphate</li> <li>• L&amp;D skin disinfectant</li> <li>• L&amp;D IV solution Ringer Lactate</li> </ul>		<ul style="list-style-type: none"> <li>• Infant weighing scale</li> <li>• Blood pressure apparatus</li> <li>• Thermometer</li> <li>• Stethoscope</li> </ul>	<ul style="list-style-type: none"> <li>• Injectable antibiotics</li> <li>• Injectable antimalarials</li> <li>• Infant/child scale</li> <li>• Thermometer</li> <li>• Stethoscope</li> <li>• Microscopy supplies</li> <li>• RDT</li> <li>• Timer</li> <li>• ORS supplies</li> </ul>
<b>Training, supervision, guidelines</b>	<ul style="list-style-type: none"> <li>• ANC trained on screening</li> <li>• ANC trained on counseling</li> <li>• ANC trained on complications</li> <li>• ANC trained on malaria</li> <li>• ANC trained on IPTp</li> <li>• ANC qualified staff</li> <li>• ANC staff supervisions</li> <li>• ANC staff with observed supervision</li> </ul>	<ul style="list-style-type: none"> <li>• L&amp;D guidelines for BEmONC</li> <li>• L&amp;D checklist/job aid</li> <li>• L&amp;D guidelines for essential childbirth observed</li> <li>• L&amp;D qualified staff</li> <li>• L&amp;D trained</li> <li>• L&amp;D guidelines for CEmONC</li> <li>• L&amp;D skilled person 24 hrs</li> <li>• L&amp;D staff supervisions</li> <li>• L&amp;D staff with observed supervision</li> </ul>	<ul style="list-style-type: none"> <li>• NB guidelines for BEmONC</li> </ul>	<ul style="list-style-type: none"> <li>• Trained on counseling for PNC</li> <li>• Trained on management of complications of pregnancy</li> <li>• Trained on PMTCT</li> <li>• Trained on nutrition counseling for newborn of mother with AIDS</li> <li>• Trained on infant and young child feeding for HIV+ mothers</li> <li>• Trained on PMTCT prophylactic treatment</li> </ul>	<ul style="list-style-type: none"> <li>• Trained on IMCI</li> <li>• Trained on iCCM (CHWs)</li> <li>• Trained on malaria diagnosis and management</li> <li>• Trained on ARI diagnosis and management</li> <li>• Trained on diarrhea management</li> <li>• Trained on pediatric HIV diagnosis and management</li> <li>• Trained on nutritional assessment</li> </ul>

					<ul style="list-style-type: none"> <li>• Supervised with observation</li> </ul>	<ul style="list-style-type: none"> <li>• IMCI guidelines observed</li> <li>• Supervised with observation</li> </ul>
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Supplemental Table S2: Components of process quality indices, by service type

L&D	Immediate newborn	Postnatal	Sick child
<ul style="list-style-type: none"> <li>• L&amp;D sterile gloves</li> <li>• L&amp;D disinfectant</li> <li>• L&amp;D gauze</li> <li>• L&amp;D clean clothes/towels to dry the baby</li> <li>• L&amp;D cloth to wrap the baby</li> <li>• L&amp;D sterile scissor or new razor blade to cut the cord</li> <li>• L&amp;D cord ligatures</li> <li>• L&amp;D Oxytocine</li> <li>• L&amp;D Ergometrine</li> <li>• L&amp;D Misoprostol</li> <li>• L&amp;D Syntometrine</li> <li>• L&amp;D eye ointment</li> <li>• L&amp;D Chlorhexidine for the newborn cord</li> <li>• L&amp;D monitor labor progress</li> <li>• L&amp;D monitor fetal heartbeat</li> <li>• L&amp;D monitor color of amniotic fluid</li> <li>• L&amp;D monitor degree of molding</li> <li>• L&amp;D monitor dilatation of the cervix</li> <li>• L&amp;D monitor descent of the head</li> </ul>	<ul style="list-style-type: none"> <li>• NB clean baby's mouth before shoulder comes out</li> <li>• NB clean baby's mouth, face and nose</li> <li>• NB ensure the baby is breathing</li> <li>• NB ensure the baby is dry</li> <li>• NB observe for color</li> <li>• NB ensure the baby is kept warm</li> <li>• NB administer prophylaxis for the eyes</li> <li>• NB weigh the baby</li> <li>• NB care for the umbilical cord</li> <li>• NB initiate breastfeed within the first hour</li> <li>• NB evaluate/examine the newborn within the first hour</li> <li>• NB resuscitation open the airways</li> <li>• NB resuscitation clean the mouth/use suction device</li> <li>• NB resuscitation stimulating/drying/wrapping the baby</li> </ul>	<p><b>History/examination</b></p> <ul style="list-style-type: none"> <li>• Initial assessment of child's health (signs and symptoms since childbirth)</li> <li>• Initial assessment of mother's health (signs and symptoms since delivery)</li> <li>• Other assessments (breastfeeding, child's weight/growth, etc.)</li> <li>• Physical examination of the child</li> <li>• Physical examination of the mother</li> </ul> <p><b>Preventive treatment</b></p> <ul style="list-style-type: none"> <li>• Iron tablets</li> <li>• Vitamin A capsule</li> <li>• Family planning method</li> </ul> <p><b>Counseling</b></p> <ul style="list-style-type: none"> <li>• Advice on preventive PNC (keeping baby warm, cord, breastfeeding, FP, postpartum hygiene, ITN)</li> <li>• Advice to seek care if child has any danger sign (fever, cold, difficulty to breastfeed, rapid/difficult breathing, etc.)</li> </ul>	<ul style="list-style-type: none"> <li>• IMCI integrated assessment index <ul style="list-style-type: none"> <li>○ Checked for 3 danger signs</li> <li>○ Checked for fever, cough/difficult breathing, and diarrhea</li> <li>○ Weighed and weight plotted on growth chart</li> <li>○ Checked for palmar or conjunctival pallor</li> <li>○ Checked health card</li> </ul> </li> <li>• Child correctly treated per provider diagnosis</li> </ul>

<ul style="list-style-type: none"> <li>• L&amp;D monitor uterine contraction</li> <li>• L&amp;D monitor maternal blood pressure</li> <li>• L&amp;D monitor maternal temperature</li> <li>• L&amp;D monitor maternal pulse</li> </ul>	<ul style="list-style-type: none"> <li>• NB resuscitation use the ambu bag</li> <li>• NB resuscitation heart massage</li> <li>• NB cord care Chlorhexidine</li> <li>• NB cord care alcohol</li> <li>• NB cord wrapped in dry cloth</li> </ul>	<ul style="list-style-type: none"> <li>• Advice to seek care if mother has any danger sign (sudden and profuse bleeding, vomiting, faintness, fever, etc.)</li> </ul>	
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Supplemental Table S3: Results of ecological linking, restricting provider dataset to public health facilities

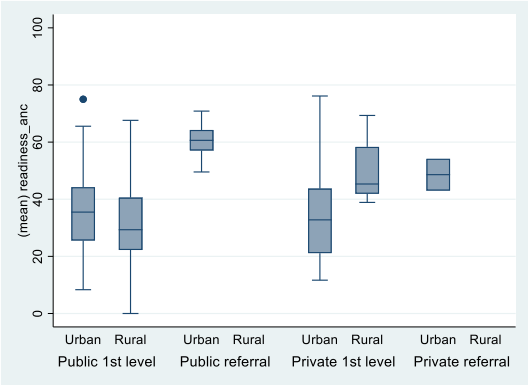
Antenatal care	ANC1				ANC4			
	Structure adjusted				Structure adjusted			
	%	95% CI lower bound	95% CI upper bound	Abs. diff.	%	95% CI lower bound	95% CI upper bound	Abs. diff.
Exact match linking	30.92%	27.09%	34.76%	REF	12.10%	8.86%	15.34%	REF
Ecological linking (Public facilities only)								
Aggregate by district (unweighted)	27.44%	24.80%	30.09%	-3.48	10.49%	8.05%	12.93%	-1.61
Aggregate by district (weighted)	34.87%	31.32%	38.42%	3.94	13.48%	10.21%	16.76%	1.38
Nearest public (straight line)	31.50%	26.90%	36.00%	0.58	13.10%	9.40%	16.80%	1.00
Nearest public (road distance)	31.00%	26.50%	35.40%	0.08	12.80%	9.30%	16.40%	0.70
10 km buffer unweighted	28.50%	24.70%	32.40%	-2.42	11.60%	8.40%	14.80%	-0.50
10 km buffer weighted	30.20%	26.10%	34.30%	-0.72	12.40%	9.00%	15.80%	0.30
Labor & delivery	Structure adjusted				Process adjusted			
	%	95% CI lower bound	95% CI upper bound	Abs. diff.	%	95% CI lower bound	95% CI upper bound	Abs. diff.
Exact match linking	37.21%	30.48%	43.94%	REF	40.11%	32.88%	47.34%	REF
Ecological linking (Public facilities only)								
Aggregate by district (unweighted)	34.40%	28.56%	40.24%	-2.81	38.57%	31.97%	45.18%	-1.53

Aggregate by district (weighted)	37.91%	31.32%	44.50%	0.70	40.60%	33.57%	47.62%	0.49
Aggregate by district and provider (unweighted)	35.75%	28.99%	42.51%	-1.46	38.38%	31.29%	45.47%	-1.73
Aggregate by district and provider (weighted)	37.54%	30.48%	44.59%	0.33	39.53%	32.22%	46.85%	-0.57
Nearest public (straight line)	37.20%	30.20%	44.20%	-0.01	39.80%	32.20%	47.40%	-0.31
Nearest public (road distance)	37.70%	30.60%	44.80%	0.49	40.60%	32.80%	48.40%	0.49
10 km buffer unweighted	36.80%	30.20%	43.30%	-0.41	40.00%	32.60%	47.40%	-0.11
10 km buffer weighted	38.00%	31.10%	45.00%	0.79	40.60%	33.00%	48.20%	0.49
Immediate newborn	Structure adjusted				Process adjusted			
	%	95% CI lower bound	95% CI upper bound	Abs. diff	%	95% CI lower bound	95% CI upper bound	Abs. diff
Exact match linking	36.14%	28.67%	43.60%	REF	56.46%	46.59%	66.32%	REF
Ecological linking (Public facilities only)								
Aggregate by district (unweighted)	31.69%	26.26%	37.12%	-4.45	55.98%	46.21%	65.74%	-0.48
Aggregate by district (weighted)	38.03%	31.37%	44.69%	1.89	56.03%	46.22%	65.84%	-0.43
Aggregate by district and provider (unweighted)	36.82%	28.92%	44.73%	0.68	53.84%	43.94%	63.73%	-2.62
Aggregate by district and provider (weighted)	38.83%	30.68%	46.99%	2.69	53.96%	44.03%	63.89%	-2.50
Nearest public (straight line)	37.90%	29.50%	46.40%	1.76	55.90%	46.00%	65.70%	-0.56
Nearest public (road distance)	39.10%	30.50%	47.60%	2.96	56.10%	46.10%	66.20%	-0.36
10 km buffer unweighted	36.70%	29.30%	44.20%	0.56	56.20%	46.30%	66.10%	-0.26
10 km buffer weighted	38.40%	30.40%	46.40%	2.26	56.50%	46.50%	66.50%	0.04
PNC for newborns	Structure adjusted				Process adjusted			
	%	95% CI lower bound	95% CI upper bound	Abs. diff	%	95% CI lower bound	95% CI upper bound	Abs. diff
Exact match linking	3.83%	1.07%	6.60%	REF	2.68%	0.78%	4.59%	REF
Ecological linking (Public facilities only)								
Aggregate by district (unweighted)	3.29%	1.06%	5.53%	-0.54	2.56%	0.83%	4.28%	-0.13
Aggregate by district (weighted)	3.97%	1.20%	6.74%	0.13	2.74%	0.89%	4.59%	0.05

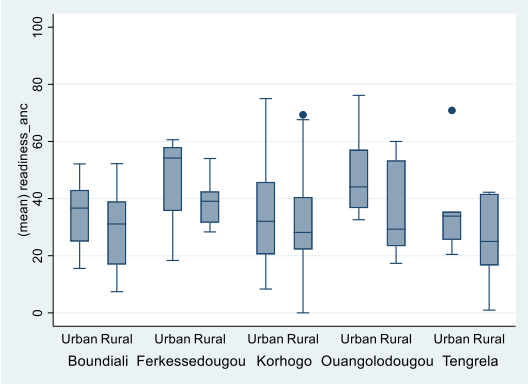
Aggregate by district and provider (unweighted)	3.11%	1.10%	5.13%	-0.72	2.20%	0.65%	3.74%	-0.49
Aggregate by district and provider (weighted)	3.50%	1.20%	5.81%	-0.33	2.36%	0.70%	4.01%	-0.33
Nearest public (straight line)	3.60%	1.20%	6.00%	-0.23	2.80%	0.80%	4.70%	0.12
Nearest public (road distance)	3.80%	1.30%	6.20%	-0.03	2.80%	0.80%	4.80%	0.12
10 km buffer unweighted	3.50%	1.10%	5.80%	-0.33	2.70%	0.70%	4.70%	0.02
10 km buffer weighted	3.90%	1.00%	6.90%	0.07	2.80%	0.70%	4.80%	0.12
PNC for mothers	Structure adjusted				Process adjusted			
	%	95% CI lower bound	95% CI upper bound	Abs. diff	%	95% CI lower bound	95% CI upper bound	Abs. diff
Exact match linking	3.21%	0.65%	5.78%	REF	2.14%	0.42%	3.86%	REF
Ecological linking (Public facilities only)								
Aggregate by district (unweighted)	2.56%	0.61%	4.51%	-0.65	1.99%	0.49%	3.48%	-0.15
Aggregate by district (weighted)	3.15%	0.72%	5.58%	-0.06	2.13%	0.53%	3.73%	-0.01
Aggregate by district and provider (unweighted)	2.36%	0.68%	4.04%	-0.86	1.12%	0.14%	2.09%	-1.02
Aggregate by district and provider (weighted)	2.59%	0.75%	4.42%	-0.63	1.20%	0.15%	2.24%	-0.94
Nearest public (straight line)	3.10%	0.90%	5.40%	-0.11	1.90%	0.40%	3.40%	-0.24
Nearest public (road distance)	3.60%	0.80%	6.30%	0.39	1.90%	0.30%	3.50%	-0.24
10 km buffer unweighted	3.20%	0.70%	5.60%	-0.01	2.00%	0.40%	3.60%	-0.14
10 km buffer weighted	3.60%	0.70%	6.40%	0.39	2.00%	0.40%	3.70%	-0.14
Care-seeking for children with fever, diarrhea, or ARI	Structure adjusted				Process adjusted			
	%	95% CI lower bound	95% CI upper bound	Abs. diff.	%	95% CI lower bound	95% CI upper bound	Abs. diff.
Exact match linking	22.90%	18.20%	27.50%	REF	18.30%	14.10%	22.40%	REF
Ecological linking (Public facilities only)								
Aggregate by district (unweighted)	23.38%	19.16%	27.60%	0.48	21.52%	17.68%	25.36%	3.22
Aggregate by district (weighted)	24.76%	20.29%	29.22%	1.86	21.14%	17.37%	24.91%	2.84
Aggregate by district and provider (unweighted)	19.43%	14.72%	24.13%	-3.47	17.40%	13.31%	21.49%	-0.90

Aggregate by district and provider (weighted)	20.18%	15.32%	25.03%	-2.72	17.10%	13.08%	21.12%	-1.20
Nearest public (straight line)	20.10%	15.00%	25.20%	-2.80	16.30%	12.00%	20.60%	-2.00
Nearest public (road distance)	19.40%	14.80%	24.00%	-3.50	16.40%	12.10%	20.70%	-1.90
10 km buffer unweighted	19.50%	14.70%	24.40%	-3.40	16.10%	12.10%	20.10%	-2.20
10 km buffer weighted	19.90%	15.00%	24.80%	-3.00	15.90%	11.80%	19.90%	-2.40

Supplemental Figure S1: ANC structural quality by facility level, managing authority and urban/rural

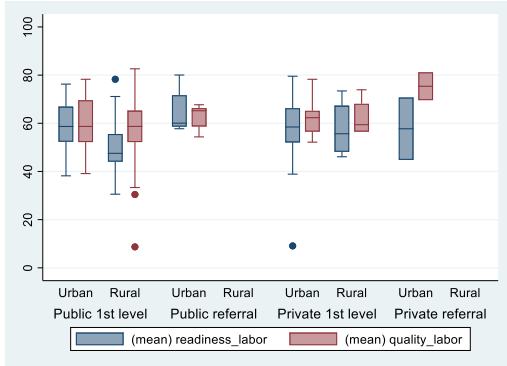


Supplemental Figure S2: ANC structural quality by district and urban/rural

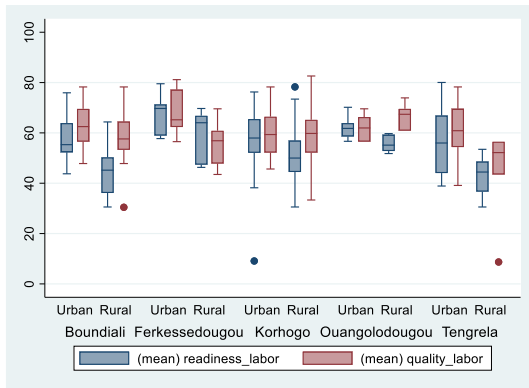




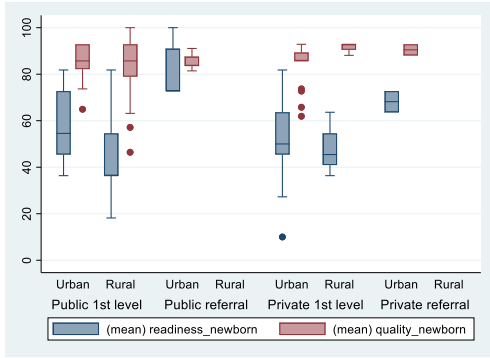
Supplemental Figure S3: Labor & delivery structural and process quality by facility level, managing authority and urban/rural



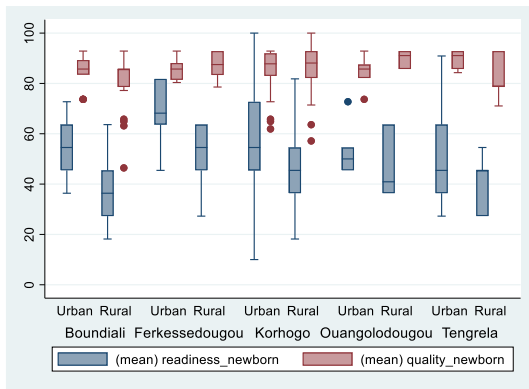
Supplemental Figure S4: Labor & delivery structural and process quality by district and urban/rural



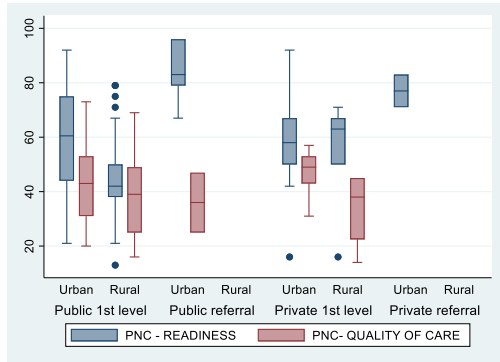
Supplemental Figure S5: Immediate newborn structural and process quality by facility level, managing authority and urban/rural



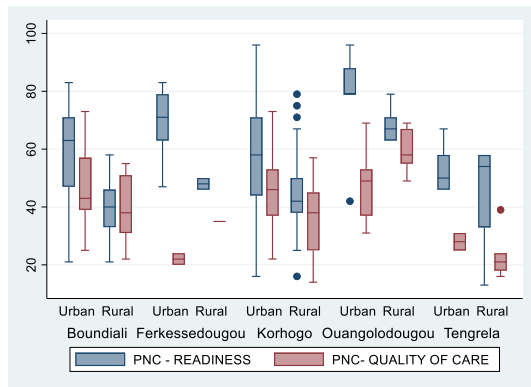
Supplemental Figure S6: Immediate newborn structural and process quality by district and urban/rural



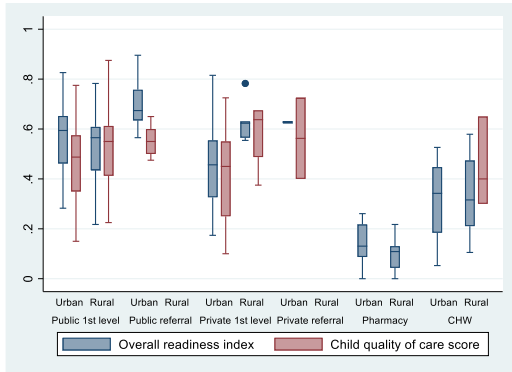
Supplemental Figure S7: PNC structural and process quality by facility level, managing authority and urban/rural



Supplemental Figure S8: PNC structural and process quality by district and urban/rural



Supplemental Figure S9: Sick child structural and process quality by facility level, managing authority and urban/rural



Supplemental Figure S10: Sick child structural and process quality by district and urban/rural

