Original Investigation

The Know-Do Gap in Quality of Health Care for Childhood Diarrhea and Pneumonia in Rural India

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IMPORTANCE In rural India, as in many developing countries, childhood mortality remains high and the quality of health care available is low. Improving care in such settings, where most health care practitioners do not have formal training, requires an assessment of the practitioners' knowledge of appropriate care and the actual care delivered (the know-do gap).

OBJECTIVE To assess the knowledge of local health care practitioners and the quality of care provided by them for childhood diarrhea and pneumonia in rural Bihar, India.

DESIGN, SETTING, AND PARTICIPANTS We conducted an observational, cross-sectional study of the knowledge and practice of 340 health care practitioners concerning the diagnosis and treatment of childhood diarrhea and pneumonia in Bihar, India, from June 29 through September 8, 2012. We used data from vignette interviews and unannounced standardized patients (SPs).

MAIN OUTCOMES AND MEASURES For SPs and vignettes, practitioner performance was measured using the numbers of key diagnostic questions asked and examinations conducted. The know-do gap was calculated by comparing fractions of practitioners asking key diagnostic questions on each method. Multivariable regressions examined the relation among diagnostic performance, prescription of potentially harmful treatments, and the practitioners' characteristics. We also examined correct treatment recommended by practitioners with both methods.

RESULTS Practitioners asked a mean of 2.9 diagnostic questions and suggested a mean of 0.3 examinations in the diarrhea vignette; mean numbers were 1.4 and 0.8, respectively, for the pneumonia vignette. Although oral rehydration salts, the correct treatment for diarrhea, are commonly available, only 3.5% of practitioners offered them in the diarrhea vignette. With SPs, no practitioner offered the correct treatment for diarrhea, and 13.0% of practitioners offered the correct treatment for pneumonia. Diarrhea treatment has a large know-do gap; practitioners asked diagnostic questions more frequently in vignettes than for SPs. Although only 20.9% of practitioners prescribed treatments that were potentially harmful in the diarrhea vignettes, 71.9% offered them to SPs ($P < .001$). Unqualified practitioners were more likely to prescribe potentially harmful treatments for diarrhea (adjusted odds ratio, 5.11 [95% CI, 1.24-21.13]). Higher knowledge scores were associated with better performance for treating diarrhea but not pneumonia.

CONCLUSIONS AND RELEVANCE Practitioners performed poorly with vignettes and SPs, with large know-do gaps, especially for childhood diarrhea. Efforts to improve health care for major causes of childhood mortality should emphasize strategies that encourage pediatric health care practitioners to diagnose and manage these conditions correctly through better monitoring and incentives in addition to practitioner training initiatives.

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Diarrhea and pneumonia remain leading drivers of mortality among children worldwide, causing 2 million deaths in 2011, including 24% of deaths among children aged 1 to 4 years.[1,2] Reducing these deaths requires investments in improved prevention, accurate diagnosis, and appropriate treatment.[3,4] Therefore, assessment of the capability of health care delivery systems is critical for the correct diagnosis and management of these conditions.[1] We herein examine the knowledge of rural pediatric health care practitioners, many of whom have no formal training, and assess the quality of care they deliver for childhood diarrhea and pneumonia in Bihar, India.

For many of Bihar's 100 million inhabitants, only low-quality pediatric health care is accessible, contributing to the highest infant mortality rate in India (55 per 1000 live births),[5,6] preventable morbidity, and esclating antibiotic resistance.[7] Documented deficiencies include low levels of knowledge and even lower levels of observed performance among these health care practitioners.[8-11] Low quality of care can occur even when health care practitioners have appropriate knowledge because of the know-do gap, whereby practitioners' actions diverge from what they know they should do.[10,12,13] Understanding know-do gaps of health care practitioners is a critical step toward developing effective, practical strategies to improve delivery of necessary health care. For example, recent empirical evidence on pay-for-performance programs suggests the potential of incentive contracts to improve health outcomes, even in low-resource settings.[14-18] With further knowledge concerning know-do gaps, appropriate training and monitoring programs to improve the quality of health care delivery can be developed, and effective regulations and incentives can then support such efforts.[19]

This study aimed to disentangle the low levels of health care practitioner knowledge from poor effort and delivery of care. We present, to our knowledge, one of the first estimates of know-do gaps in the context of health care systems in developing countries that uses a standardized patient (SP) method for rigorously measuring the performance of health care practitioners.[13,20,21] We analyzed data from interviews with health care practitioners using vignettes to estimate competence in terms of knowledge as to what care these practitioners would provide for a hypothetical patient[22] and compared the responses with data from SP-based assessments that accurately describe what practitioners did when they were presented with the same case. The know-do gap is the difference between the 2 measures.

Methods

Study Design

The study protocol of the Bihar Evaluation of Social Franchising and Telemedicine (BEST) project was approved by Duke University (approval No. 29755) and India's Health Ministry Steering Committee (No.12/2008/30-HMSC/4). Three hundred forty health care practitioners provided oral informed consent. We assessed the quality of health care provided for childhood diarrhea and pneumonia using data collected from June 29 through September 8, 2012, as part of the BEST project evaluation of a large-scale telemedicine program.[23] Among 360 clusters in the BEST project, 80 were selected at random for the study described herein. Each cluster consists of a group of geographically contiguous villages within 11 districts of Bihar. We generated a list of all health care practitioners visited in the past 6 months—regardless of medical qualifications—from interviews with 64 randomly selected households with children younger than 5 years. Although the study included the 5 most frequently visited primary health care practitioners in each cluster, our analytical sample is restricted to 340 practitioners for whom we had complete data from the vignettes and SPs. Using this restricted sample yields a consistent sample size for our analyses. All of our results remain consistent regardless of the sample used (justification and sample comparison are available in the eMethods and eTables 1 and 2 in the Supplement).

Data

The study used 3 data sources collected before implementation of the telemedicine intervention in the BEST project. Surveys captured information on the characteristics of the health care practitioners, including age, educational level, medical training, experience, and types of illnesses treated. Vignettes and SPs were used to measure the knowledge of the practitioners and the quality of care. The health care practitioners consented to vignette interviews and visits by unannounced SPs within 2 months; 178 practitioners were randomized to receive SPs presenting with childhood diarrhea, and 162 were randomized to receive SPs presenting with childhood pneumonia.

Measuring Knowledge Using Vignettes

The vignettes estimate the clinical knowledge of health care practitioners by presenting a hypothetical case in an interview setting administered by 2 interviewers.[9,22,24] In the diarrhea vignette, health care practitioners are told that a father seeks treatment for his 2-year-old son who has had loose stools for 2 days. While interviewer 1 records questions asked by the health care practitioners, interviewer 2 reads scripted responses aloud. For the pneumonia vignette, the treating practitioner is informed that the child has had a fever and a cough for 5 days and appears to have trouble breathing (vignettes are available at http://cohesiveindia.org/publications-downloads.html).

Measuring Quality/Effort Using SPs

Although vignettes measure the knowledge of practitioners, they do not measure actual care delivered. Previous studies of know-do gaps have typically used methods whereby practitioners are observed by interviewers, but this method is vulnerable to Hawthorne effects.[13,25] In addition, limitations from case mix and self-selection of patients make comparisons across practitioners difficult.[9,12,25] The SP method is considered the criterion standard for practitioner performance measurement because it presents a well-defined incognito case in a clinically accurate and consistent manner to all practitioners.[13,20,26]

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Following the methods of Das et al,[13] we used a proxy SP case in which a father seeks treatment for his ill 2-year-old child; the child is not present for the interaction. This pattern of health care, in which a family member seeks care on behalf of the sick patient, is common in India[27] and enables use of SP methods without putting a child at risk. The first case is a child with diarrhea (likely caused by rotavirus infection) but no clinical signs of dehydration for whom the only medical therapy indicated, aside from food-based fluids (eg, soup) or clean water, consists of oral rehydration salts (ORSs) to prevent dehydration.[28] The second proxy case is a child with pneumonia (as defined by a cough and rapid breathing) who requires antibiotic treatment; given that the father also reports signs of respiratory distress, this child meets the criteria for severe pneumonia and needs an urgent referral for hospitalization.[29] Immediately after the interaction, SPs were debriefed using exit interviews that recorded details of the interaction.

For diarrhea, correct treatment was defined to include ORSs with or without zinc supplements, with no prescription of unnecessary or potentially harmful drugs according to the 2005 World Health Organization guidelines.[28] The 2013 World Health Organization recommendations[30] include ORS and zinc supplementation. The correct treatment for severe pneumonia was defined to include appropriate antibiotics, absence of potentially harmful drugs, and referral to a hospital.[29] Because our sample consisted exclusively of practitioners in outpatient settings, we do not have data on hospitalization and referrals and instead focus on the drugs prescribed. For the SPs and vignettes, performance was measured using the numbers of key diagnostic questions asked and examinations conducted. We used item response theory (IRT) to compute performance scores separately for SPs and vignettes following previously described methods.[9,31] All analyses, including IRT scores, relied on a subset of 12 essential questions that help to diagnose the cause and severity of disease (eTable 3 in the Supplement). We refer to IRT-based performance for vignettes as the *knowledge score* and for SPs as the *performance score*.

Statistical Analysis

We tested for differences in characteristics between practitioners with and without medical qualifications using unpaired 2-tailed *t* tests and χ^2 tests of proportions. We then compared practitioners' knowledge for vignettes and performance with SPs to characterize know-do gaps as the fraction of practitioners who asked key diagnostic questions on each method.

We used regression analyses to examine associations among practitioners' observable characteristics, performance, and the know-do gap. We estimated multivariable regressions in which the outcome is practitioner performance measured as the percentage of diagnostic questions asked for diarrhea and pneumonia. We checked the robustness of our findings using fractional logit models that account for the outcome having values ranging from 0 to 1. We conducted logistic regressions for the prescription of potentially harmful treatments (yes/no) for each case. All regressions control for age; medical qualification; practitioners' work hours; patient volume; whether practitioners engage in public events, such as medical camps; whether the clinic is public or private; and clinic cleanliness as observed by the investigators. Analyses were adjusted for SEs for those practitioners who were sampled within clusters.

Results

Practitioners

Of the 340 practitioners included in this study, 80.0% had no formal medical degrees in allopathy, Ayurveda, homeopathy, or Unani medicine, which is consistent with other studies of health care in rural India[32] (**Table 1**). Qualified practitioners had a higher caseload, worked longer hours, and were more likely to work in public facilities. We found no significant differences in mean years of experience between qualified and unqualified practitioners. Qualified practitioners are more likely to spend time on skill-oriented activities, such as consultation and laboratory-related duties, and less time selling drugs. Approximately 90% of all practitioners reported frequent prescription of allopathic treatments. Almost all practitioners reported treating diarrhea (98.5% of those with qualifications and 96.7% of those without), whereas fewer practitioners without formal qualifications reported treating pneumonia (81.6% vs 92.6%). However, even practitioners who reported that they do not treat patients with a stated condition actually do provide treatment because they may not always provide the correct diagnosis for these conditions.

Vignettes

Practitioners demonstrated low levels of knowledge of key diagnostic questions and examinations (**Table 2**). The most commonly asked question for diarrhea concerned the nature of stools (60.6%); 46.2% asked about the frequency of stools. Only 32.9% asked questions that provide critical information about dehydration severity (eg, weakness, ability to take fluids, and urinary frequency). Most practitioners (86.8%) failed to ask about blood in stools to distinguish the simple case of viral diarrhea from possible dysentery. Among the diagnostic questions and examinations for diarrhea listed in Table 2, practitioners asked a mean of 2.9 questions and suggested a mean of 0.3 examinations.

For pneumonia, 33.2% of practitioners asked questions about fever, but only 24.1% asked about rapid breathing, and 20.9% asked about visual signs of respiratory distress (drawing in of the chest and nasal flaring were present in this case). Although difficulty in breathing was voluntarily described in the presenting complaints, only 10.9% of practitioners said they would auscultate the child's chest (Table 2). Practitioners asked a mean of 1.4 questions and performed a mean of 0.8 examinations for pneumonia.

Despite seeking little diagnostic information, almost all practitioners made a diagnosis and prescribed treatments. Among 99.1% of practitioners with a diagnosis for diarrhea, 74.5% were correct. This finding did not surprise us because the diagnosis in the local language is a term for loose stools. Although ORSs are a commonly available treatment, only 3.5% of practitioners offered the correct ORS treatment, whereas 20.9% prescribed unnecessary antibiotics, corticosteroids, and other potentially harmful drugs without ORSs

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Table 1. Practitioner Characteristics According to Medical Qualification

Characteristic	Data, Mean (SD)[a]		P Value
	No Medical Qualification (n = 272)[b]	Medical Qualification (n = 68)[c]	
Age, y	43.6 (11.2)	45.5 (10.7)	.19
Educational level beyond high school	70.2 (45.8)	100 (0.0)	<.001
Ever used a computer	11.4 (31.8)	47.1 (50.3)	<.001
Experience, y	18.3 (10.7)	18.0 (10.2)	.87
Patient caseload, No./d	17.2 (7.0)	20.3 (10.6)	.02
Time working, h/wk	48.6 (17.6)	57.5 (16.6)	<.001
Run camps	4.4 (20.6)	17.6 (38.4)	<.001
Work in public health facility	0.4 (6.1)	8.8 (28.6)	<.001
Infrastructure index[d]	−0.4 (0.9)	1.2 (2.9)	<.001
Consultation fee, Rs	14.4 (17.4)	45.6 (47.3)	<.001
Tasks			
Consult with patients	99.6 (6.1)	100 (0.0)	.62
Administer treatment	91.2 (28.4)	69.1 (46.5)	<.001
Sell drugs	55.9 (49.7)	26.5 (44.4)	<.001
Laboratory-related duties	4.0 (19.7)	7.4 (26.3)	.25
Administrative duties	63.6 (48.2)	63.2 (48.6)	.96
Ownership	72.8 (44.6)	66.2 (47.7)	.28
Type of medicine practiced			
Allopathic	90.8 (28.9)	89.7 (30.6)	.78
Homeopathic/ayurvedic	34.9 (47.8)	45.6 (50.2)	.10
Type of diseases treated			
Diarrhea	96.7 (17.9)	98.5 (12.1)	.42
Pneumonia	81.6 (38.8)	92.6 (26.3)	.03
IRT scores			
Knowledge: combined	−1.37 (2.53)	−0.84 (2.15)	.07
Knowledge: diarrhea	−0.93 (2.21)	−0.49 (1.82)	.15
Knowledge: pneumonia	−1.81 (2.75)	−1.42 (2.53)	.43
Performance: combined	−1.31 (2.58)	−1.58 (2.64)	.42
Performance: diarrhea	−1.73 (2.68)	−1.20 (2.56)	.23
Performance: pneumonia	−0.89 (2.42)	−2.19 (2.69)	.02

Abbreviation: IRT, item response theory.

[a] Unless otherwise indicated, data are expressed as percentage of practitioners. Data are obtained from the practitioner questionnaire, standardized patient exit interview, and vignettes.

[b] Includes all practitioners with null medical training or courses/degree related in some way to medicine, such as pharmacy.

[c] Includes practitioners with a master's or a bachelor's degree (bachelor of medicine, bachelor of surgery; bachelor of ayurvedic medicine and surgery; and bachelor of homeopathic medicine and surgery) and diploma in ayurvedic medicine and some other doctor of medicine degrees.

[d] Computed from principal components analysis using the following variables: electricity, power backup, number of consulting rooms, number of beds for day observation, provision of tests, provision of radiological examinations, and a computer system. The resulting index score is a standardized score with a mean of 0 and an SD of 1. Negative values represent practitioners with an infrastructure index below the mean, and positive values represent practitioners with an infrastructure index above the mean.

or zinc. (The drug list is available at http://cohesiveindia.org/publications-downloads.html). Another 68.8% prescribed ORSs with other unnecessary treatments (**Table 3**). When asked at the end of the vignette if the drugs prescribed included antibiotics, 12.6% of practitioners reported not prescribing antibiotics when in fact they had.

For pneumonia, 59.0% of all practitioners made the correct diagnosis of pneumonia. Only 8.8% of practitioners prescribed the correct treatment. An additional 43.8% offered antibiotics with unnecessary, potentially harmful drugs, such as allergy medications and drugs for cardiac conditions. The relatively high share of practitioners prescribing antibiotics likely reflects the general overprescription of antibiotics irrespective of the patients' conditions.[33,34] The most commonly prescribed incorrect treatments included corticosteroids or vitamin syrups without any antibiotics.

Standardized Patients

Practitioner effort, measured in their interactions with SPs, was low (**Table 4**). Practitioners spent a mean (SD) of 1.6 (1.7) minutes with the SP with diarrhea and 2.9 (3.8) minutes with the SP with pneumonia (eFigure 1 in the Supplement shows the distribution of time). Practitioners asked a mean of 2.7 essential questions for diarrhea and 2.8 for pneumonia, covering less than 30% of the questions needed to diagnose the cause and severity of the disease. Despite cursory consultations, practitioners prescribed a mean of 1.8 medicines for diarrhea and 2.2 medicines for pneumonia.

Practitioners asked the SPs even fewer questions about the severity of the disease than they did with the vignettes (Table 4). Although 45.5% of practitioners asked the SP with diarrhea about the quality of stools, only 29.8% asked about frequency, 2.2% about urination, and 2.8% about the child's activity level. Similarly, only 27.2% asked the SP with pneumonia about rapid breathing, and 24.7% asked about signs of respiratory distress. Other than age, the most commonly asked question was about fever (61.1%), which was one of the presenting complaints described by the SP.

Practitioners participating in the SP method frequently offered treatment despite not seeing the child. Although

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Table 2. Percentage of Practitioners Who Asked Key Diagnostic Questions and Performed Key Examinations, Diagnosis, and Treatment in Vignettes (N=340)

	No. (%) of Practitioners	
	Treating Diarrhea	Treating Pneumonia
Key Diagnostic Questions and Examinations		
Fever/child warm	68 (20.0)	NA
Urine/color normal	27 (7.9)	NA
Time of last urination	24 (7.1)	NA
Nature of stool	206 (60.6)	NA
Frequency of stool	157 (46.2)	NA
Quantity of stool	43 (12.6)	NA
Blood or mucus in the stool	45 (13.2)	NA
Worms in stool	21 (6.2)	NA
Foul-smelling stool	40 (11.8)	NA
Stomachache	75 (22.1)	NA
Weak now	30 (8.8)	NA
Vomiting	172 (50.6)	NA
Drinking a lot of water	70 (20.6)	NA
Weight of child	23 (6.8)	18 (5.3)
Temperature	26 (7.6)	NA
Mucous membranes checked for moistness	14 (4.1)	NA
Skin color and turgor	19 (5.6)	NA
Palpation of the abdomen	22 (6.5)	NA
High fever	NA	113 (33.2)
Cough continuous	NA	60 (17.6)
Cough increases at night	NA	30 (8.8)
Fever and cough started 5 d ago	NA	34 (10.0)
Runny/blocked nose	NA	29 (8.5)
Breathing rapidly	NA	82 (24.1)
Nostrils appear to be flaring when breathing	NA	34 (10.0)
Noticed skin between the ribs or the stomach moves inward when breathing	NA	47 (13.8)
Any particular sounds that the child made since difficult breathing started	NA	40 (11.8)
Breathlessness in the past	NA	17 (5.0)
Respiration rate	NA	16 (4.7)
Auscultation of chest and heart	NA	37 (10.9)
Pulse rate	NA	18 (5.3)
Temperature	NA	62 (18.2)
Examination of chest	NA	28 (8.2)
Chest radiograph	NA	27 (7.9)
Total leukocyte count	NA	30 (8.8)
WBC differential	NA	36 (10.6)
Other Questions		
Expressed not having given antibiotics when they did	36 (12.6)	3 (1.1)
Diagnosis		
Gave any diagnosis	337 (99.1)	332 (97.6)
Correct diagnosis	251 (73.8)	196 (57.6)
Correct diagnosis, if any[a]	251 (74.5)	196 (59.0)
Treatment		
Gave any treatment	338 (99.4)	324 (95.3)
Correct treatment	12 (3.5)	30 (8.8)
Correct treatment, if any[b]	12 (3.6)	30 (9.3)

Abbreviations: NA, not applicable; WBC, white blood cell count.

[a] Indicates of the 337 practitioners who gave any diagnosis in the diarrhea vignette and the 332 practitioners who gave any diagnosis in the pneumonia vignette.

[b] Indicates of the 338 practitioners who gave any treatment in the diarrhea vignette and the 324 practitioners who gave any treatment in the pneumonia vignette.

23.6% asked the SP to return with the child for diarrhea, 92.7% prescribed treatment (for the SP with pneumonia, 32.7% and 79.0%, respectively). The proportion of practitioners who prescribed the correct treatment to the SP was far lower for diarrhea (0) compared with pneumonia (13.0%).

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Table 3. Type of Treatment Provided for Diarrhea and Pneumonia in SP Interactions and Vignettes[a]

Treatment Prescribed	No. (%) of Practitioners	
	Vignette	SP
For Diarrhea[b]		
ORS ± zinc	8 (2.3)	0
ORS + Ayurveda/homeopathy/ intravenous bottles/glucose	4 (1.2)	0
ORS + antibiotics	143 (42.1)	18 (10.1)
ORS + antibiotics + other[c]	79 (23.2)	12 (6.7)
ORS + others (no antibiotics)[c]	12 (3.5)	1 (0.6)
No ORS, no harmful drugs	21 (6.2)	6 (3.4)
No ORS + harmful drugs (antibiotics or others)	71 (20.9)	128 (71.9)
No treatment	2 (0.6)	13 (7.3)
For Pneumonia[d]		
Antibiotics ± nonharmful drugs	10 (2.9)	4 (2.5)
Antibiotics + analgesics ± nonharmful drugs	18 (5.3)	19 (11.7)
Antibiotics + analgesics + unnecessary drugs ± nonharmful drugs	106 (31.2)	53 (32.7)
Antibiotics + unnecessary drugs ± nonharmful drugs	150 (44.1)	28 (17.3)
No antibiotics	40 (11.8)	24 (14.8)
No treatment	16 (4.7)	34 (21.0)

Abbreviations: ORS, oral rehydration salts; SP, standardized patient.

[a] Data were obtained from the SP and vignette exit interviews.

[b] Includes 340 practitioners for the vignette and 178 for the SP.

[c] May include analgesics, antiulcer medication, antiallergy medicine, corticosteroids, cardiac medication, or psychiatric/neural medicine.

[d] Includes 340 practitioners for the vignette and 162 for the SP. All drug categories in addition to antibiotics may include nonharmful medication, such as vitamins.

Know-Do Gap

We found a clear know-do gap for diarrhea: practitioners reported during the vignette that they would ask diagnostic questions far more often than they asked the SP (eFigure 2 in the Supplement). For example, although 46.2% of practitioners asked about the frequency of stools in the vignette, only 29.8% asked the SP. For pneumonia, practitioners' generally poor performance was roughly comparable between the vignette and the SP.

Likewise, the know-do gap for treatments offered is larger for diarrhea than for pneumonia (Table 3). For the diarrhea vignette, 72.4% of practitioners reported that they would offer ORSs (often in combination with other drugs); only 17.4% actually offered this type of treatment to the SP. Another critical dimension of the large know-do gap for diarrhea is reflected in practitioners prescribing potentially harmful treatments to the SP and not in the vignette. Compared with 20.9% of practitioners who said they would prescribe only potentially harmful treatments without ORSs for the vignette, 71.9% offered such treatments to the SP ($P < .001$). For pneumonia, this gap is smaller. Although 11.8% of practitioners reported that they would not prescribe antibiotics (classified as the incorrect treatment), 14.8% did not prescribe antibiotics ($P = .09$) to the SP.

Table 4. Diagnostic Questions Asked and Diagnosis and Treatment Given in SP-Practitioner Interactions[a]

SP-Practitioner Interaction	SP With Diarrhea (n = 178)	SP With Pneumonia (n = 162)
Key Diagnostic Questions and Examinations		
Age of child	166 (93.3)	156 (96.3)
Nature of stool	81 (45.5)	NA
Frequency of stool	53 (29.8)	NA
Quantity of stool	21 (11.8)	NA
Questions about urination	4 (2.2)	NA
Child is active/playful	5 (2.8)	NA
Fever	28 (15.7)	NA
Abdominal pain	33 (18.5)	NA
Vomiting	38 (21.3)	NA
What has the child eaten	20 (11.2)	NA
Taking fluids	23 (12.9)	NA
Fever	NA	99 (61.1)
Breathing is rapid	NA	44 (27.2)
Difficulty in breathing/nostrils flaring/skin between ribs moves inward/neck muscles are strained	NA	40 (24.7)
Type of cough	NA	56 (34.6)
Runny/blocked nose	NA	23 (14.2)
Sounds while breathing	NA	12 (7.4)
Child is weak	NA	7 (4.3)
Breastfeeding/immunization history	NA	11 (6.8)
Other Questions		
Father was asked to bring the child to clinic	42 (23.6)	53 (32.7)
Counseling on hygiene, especially washing hands	4 (2.2)	NA
Asked if other children have similar symptoms	NA	3 (1.9)
Diagnosis		
Gave any diagnosis	11 (6.2)	19 (11.7)
Correct diagnosis	6 (3.4)	13 (8.0)
Correct diagnosis, if any[b]	6 (54.5)	13 (68.4)
Treatment		
Gave any treatment	165 (92.7)	128 (79.0)
Correct treatment	0	21 (13.0)
Correct treatment, if any[c]	0	21 (16.4)
Length of SP Interaction, Questions Asked, and Medicines Prescribed, Mean (SD)		
Visit length, min	1.6 (1.7)	2.9 (3.8)
Total No. of 12 essential questions asked by practitioners	2.7 (1.9)	2.8 (1.6)
No. of medicines prescribed/dispensed	1.8 (1.1)	2.2 (1.4)

Abbreviations: NA, not applicable; SP, standardized patient.

[a] Unless otherwise indicated, data are expressed as number (percentage) of practitioners. Data were obtained from the SP exit interview.

[b] Indicates of the 11 practitioners who gave any diagnosis in the diarrhea vignette and the 19 practitioners who gave any diagnosis in the pneumonia vignette.

[c] Indicates of the 165 practitioners who gave any treatment in the diarrhea vignette and the 128 practitioners who gave any treatment in the pneumonia vignette.

Practitioner Effort and Characteristics

Practitioners asked the SP only 24.1% and 30.7% of the essential questions for diarrhea and pneumonia, respectively (Table 4). **Table 5** shows the associations between practitioner characteristics and the percentage of diagnostic questions asked. Practitioners in public facilities asked the SPs sig-

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Table 5. Regression Analysis of Practitioner Characteristics on Practitioner Performance[a]

Characteristic	Percentage of Diagnostic Questions Asked (OLS)				Prescribed Harmful Treatment (Logistic)			
	Estimated Effect, % (95% CI)[b]	*P* Value	Estimated Effect, % (95% CI)[b,c]	*P* Value	OR (95% CI)[b]	*P* Value	OR (95% CI)[b,c]	*P* Value
Diarrhea								
Age, y[d]								
20-29	7.5 (−5.4 to 20.5)	.25	6.3 (−4.7 to 17.3)	.26	0.38 (0.05 to 2.61)	.32	0.42 (0.06 to 2.84)	.36
40-49	−0.7 (−9.0 to 7.5)	.86	0.1 (−7.3 to 7.5)	.98	3.82 (0.64 to 22.81)	.14	3.63 (0.62 to 21.33)	.15
50-59	−0.9 (−10.9 to 9.0)	.85	−1.4 (−10.6 to 7.8)	.76	1.99 (0.17 to 23.65)	.59	2.10 (0.17 to 26.20)	.56
≥60	7.8 (−8.4 to 24.0)	.34	5.5 (−10.4 to 0.2)	.50	0.32 (0.02 to 4.91)	.41	0.41 (0.02 to 7.26)	.54
Experience, y	−0.0 (−0.5 to 0.4)	.91	0.0 (−0.4 to 0.5)	.83	1.02 (0.91 to 1.14)	.76	1.02 (0.91 to 1.13)	.78
Medical qualifications[e]	4.0 (−3.0 to 11.1)	.26	6.0 (−1.6 to 13.6)	.12	3.92 (1.24 to 12.43)	.020	5.11 (1.24 to 21.13)	.02
Work time, h/wk	NA		−0.2 (−0.4 to −0.1)	.004	NA		1.02 (0.98 to 1.05)	.33
Mean caseload	NA		−0.2 (−0.4 to 0.1)	.15	NA		1.03 (0.98 to 1.08)	.25
Runs camps	NA		3.7 (−9.2 to 16.6)	.57	NA		1.58 (0.18 to 13.82)	.68
Works in public facility	NA		−16.1 (−27.5 to −4.8)	.006	NA		1.09 (0.11 to 10.80)	.95
Cleanliness	NA		−1.1 (−5.8 to 3.6)	.63	NA		1.43 (0.63 to 3.24)	.39
Knowledge IRT score[f]	NA		3.3 (1.0 to 5.6)	.005	NA		1.11 (0.54 to 2.27)	.77
R^2 value	0.059		0.153		0.166		0.192	
Pneumonia								
Age, y[d]								
20-29	−11.3 (−20.2 to −2.3)	.01	−11.0 (−20.8 to −1.2)	.03	1.10 (0.22 to 5.55)	.90	1.09 (0.17 to 7.02)	.93
40-49	−0.3 (−8.0 to 7.3)	.93	0.3 (−7.6 to 8.2)	.94	1.56 (0.64 to 3.83)	.33	1.76 (0.70 to 4.39)	.23
50-59	3.5 (−7.1 to 14.0)	.52	4.0 (−7.9 to 15.9)	.51	1.37 (0.33 to 5.75)	.65	2.05 (0.48 to 8.79)	.34
≥60	10.3 (−2.6 to 23.3)	.12	7.3 (−8.2 to 22.7)	.35	0.58 (0.11 to 2.99)	.51	0.61 (0.10 to 3.75)	.60
Experience, y	−0.4 (−0.9 to −0.0)	.046	−0.4 (−0.9 to 0.0)	.08	1.02 (0.96 to 1.08)	.52	1.02 (0.96 to 1.08)	.61
Medical qualifications[e]	−9.5 (−17.7 to −1.3)	.02	−8.4 (−16.0 to −0.7)	.03	2.09 (0.90 to 4.83)	.09	2.19 (0.88 to 5.45)	.09
Work time, h/wk	NA		−0.3 (−0.5 to −0.1)	.02	NA		0.99 (0.96 to 1.01)	.36
Mean caseload	NA		−0.0 (−0.4 to 0.4)	.98	NA		1.01 (0.95 to 1.08)	.67
Runs camps	NA		1.0 (−9.1 to 11.1)	.85	NA		3.43 (0.17 to 67.71)	.42
Works in public facility	NA		−24.9 (−34.8 to −15.0)	<.001	NA			
Cleanliness	NA		5.3 (0.3 to 10.2)	.04	NA		1.56 (0.79 to 3.10)	.21
Knowledge IRT score[f]	NA		0.7 (−2.3 to 3.6)	.66	NA		1.04 (0.72 to 1.50)	.83
R^2 value	0.111		0.211		0.109		0.140	

Abbreviations: IRT, item response theory; NA, not applicable; OLS, ordinary least squares; OR, odds ratio.

[a] Data are obtained from the practitioner questionnaire, standardized patient exit interview, and vignettes for 340 practitioners.

[b] Adjusted for the time and day of the week of the consultation and practitioners' age group, years of experience, and qualifications.

[c] Adjusted in addition for covariates listed below.

[d] Practitioners aged 30 to 39 years are the reference group.

[e] Described in Table 1.

[f] Based on practitioners' responses to 12 key questions listed in eTable 1 in the Supplement.

nificantly fewer questions (16 percentage points fewer for diarrhea [*P* = .006] and 25 percentage points fewer for pneumonia [*P* < .001]), controlling for measures of patient volume, type of practice, knowledge IRT scores, the practitioners' age group, and the practitioners' experience. Those practitioners with more working hours per week asked fewer diagnostic questions for the SPs with diarrhea (0.2 percentage points [*P* = .004]) and pneumonia (0.3 percentage points [*P* = .02]). Medical qualifications were associated with 8.4 percentage points fewer (*P* = .03) diagnostic questions for pneumonia. Practitioners with higher knowledge scores about diarrhea also asked more diagnostic questions (*P* = .005). Unlike the SPs, for the vignettes, we found no significant or large associations between other practitioner characteristics and the number of questions asked (eTable 4 in the Supplement). Results were highly similar when we used fractional logit regressions (eTable 5 in the Supplement).

Being an unqualified practitioner predicted a significantly higher likelihood of prescribing potentially harmful treatments (Table 5) for diarrhea compared with qualified practitioners (adjusted odds ratio, 5.11 [95% CI, 1.24-21.13]). For pneumonia, the adjusted odds ratio was 2.19 (95% CI, 0.88-5.45). Results were generally similar when performance IRT score was used as the outcome (eTable 6 in the Supplement).

Discussion

In rural India, pediatric health care practitioners demonstrated low levels of knowledge during vignettes for child-

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hood diarrhea and pneumonia. We also found a large know-do gap in the practitioners' treatment of childhood diarrhea but not pneumonia. In these settings, medically qualified practitioners offered far fewer potentially harmful treatments compared with unqualified practitioners.

Although 72.4% of practitioners reported that they would prescribe ORS treatment in the diarrhea vignette, only 17.4% actually prescribed ORSs to the SP, with the remainder prescribing potentially harmful drugs instead. Understanding factors that lead to this large know-do gap is critical to reducing preventable deaths due to diarrhea. The know-do gap for diarrhea appears paradoxical because most practitioners in our sample are in private practice and thus should be able to benefit financially from better performance unless patients cannot differentiate practitioner quality (an asymmetric information problem).[35] The severity of this asymmetry may be seen in the lack of robust correlation between practitioner characteristics and performance with SPs; practitioner characteristics explain only 12% to 20% of the variation in performance.

The smaller know-do gap for pneumonia is striking. Among practitioners in our sample, 83.8% claimed to treat pneumonia (97.1% for diarrhea), suggesting that they might consider pneumonia to be more critical than diarrhea and might exert higher effort. However, because the technically correct treatment includes a referral for hospitalization, which we did not observe, the true rates of correct treatment are likely lower than the 13.0% that we report. Mean consultation time for pneumonia was almost twice that for diarrhea, yet was still short. Although the know-do gap for pneumonia was small, the level of practitioner knowledge during vignettes was very low. Our findings of low levels of practitioner knowledge and effort and that public practitioners had worse performance with SPs are consistent with previous research.[10,11,36,37]

Although our SP methods represent substantial improvements over other methods for measuring the quality of health care practitioners deliver in developing countries, they have limitations. First, the study is restricted to cases for whom the interviewers did not face any risk. Second, we used proxy cases presented by a parent of a sick child, although this presentation is common in India. From previous studies, these limitations do not affect measurements of practitioner quality but do present challenges for implementing similar methods in other contexts. Furthermore, because the presentations of patients were standardized, we do not know how practitioners might perform given a different set of symptoms. Nonetheless, the cases we chose are simple, uncomplicated presentations of conditions seen commonly in primary care in rural areas, making the findings important on their own merit. Finally, the absence of data on referrals for hospitalization for pneumonia cases suggests that our estimated rate of correct treatment (13.0%) represents the upper bound.

Although medically qualified practitioners do less harm than their unqualified counterparts, most practitioners in rural areas are unqualified.[32,38,39] Although practitioners asked few questions and spent very little time with the patient, almost all practitioners, including the unqualified ones, prescribed treatments, none of which were correct for diarrhea and only 13.0% of which were correct for pneumonia.

Conclusions

Our findings highlight the need to better understand why pediatric practitioners in developing countries fail to correctly diagnose and manage the 2 leading causes of childhood mortality. The know-do gap we document supports the argument that more training focused on increasing knowledge alone is insufficient. Understanding the incentives faced by practitioners as well as the potential role of patients who do not have adequate information about practitioner performance and quality are critical. How such information can be appropriately communicated and targeted to patients in developing countries to counteract the know-do gap remains a major challenge.

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