Quality of Case Management for Pneumonia and Diarrhea among Children Seen at Health Facilities in Southern Malawi

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Abstract. Pneumonia and diarrhea are leading causes of child deaths in Malawi. Guidelines to manage childhood illnesses in resource-poor settings exist, but studies have reported low health-care worker (HCW) adherence to guidelines. We conducted a health facility survey from January to March 2015 to assess HCW management of pneumonia and diarrhea in children < 5 years of age in southern Malawi, and to determine factors associated with case management quality. Descriptive statistics and multivariable logistic regression models examined patient, HCW, and health facility factors associated with recommended pneumonia and diarrhea management, using Malawi's national guidelines as the gold standard. Of 694 surveyed children 2–59 months of age at 95 health facilities, 132 (19.0%) met survey criteria for pneumonia; HCWs gave recommended antibiotic treatment to 90 (68.2%). Of 723 children < 5 years of age, 222 (30.7%) had uncomplicated diarrhea; HCWs provided recommended treatment to 94 (42.3%). In multivariable analyses, caregivers' spontaneous report of children's symptoms was associated with recommended treatment of both pneumonia (odds ratio [OR]: 2.8, 95% confidence interval [CI]: 1.2–6.8, $P = 0.023$) and diarrhea (OR: 24.2, 95% CI: 6.0–97.0, $P < 0.001$). Malaria diagnosis was negatively associated with recommended treatment (OR for pneumonia: 0.5, 95% CI: 0.2–1.0, $P = 0.046$; OR for diarrhea: 0.3, 95% CI: 0.1–0.6, $P = 0.003$). To improve quality of care, children should be assessed systematically, even when malaria is suspected. Renewed efforts to invigorate such a systematic approach, including HCW training, regular follow-up supervision, and monitoring HCW performance, are needed in Malawi.

INTRODUCTION

Pneumonia and diarrhea together account for approximately 30% of all child deaths globally, and every year, more than two million children die of one or both of these two diseases.¹ Between 1990 and 2013, Malawi saw a dramatic decline in its under-five mortality rate, from 247 to 71 deaths per 1,000 live births, and achieved the 2015 Millennium Development Goal 4 to reduce under-five mortality by two-thirds between 1990 and 2015.² According to a recent country case study, increases in the number of children receiving appropriate treatment of diarrhea, pneumonia, and malaria were responsible for 23% of the lives saved from 2001 to 2013.² Despite these advances, malaria, pneumonia, and diarrhea remained the leading causes of deaths in children 1–59 months of age in 2013 in Malawi, accounting for an estimated 14%, 13%, and 7% of deaths, respectively.^{2,3}

Integrated management of childhood illness (IMCI) is a key strategy for improving treatment of potentially life-threatening illnesses in children.⁴ IMCI was developed by World Health Organization (WHO) and United Nations Children's Emergency Fund in the 1990s and provides guidance for the diagnosis and management of common pediatric conditions using a set of clinical algorithms.^{5,6} IMCI has been introduced in more than 100 countries, including Malawi in 1999.⁵ Under IMCI, health-care workers (HCWs) are trained and resourced to assess all sick children systematically for key signs and

symptoms and treat accordingly. All children 2–59 months of age are first assessed for general danger signs, then for cough or difficult breathing, diarrhea, fever, ear problem, acute malnutrition, anemia, and human immunodeficiency virus infection.⁷ Children < 2 months of age have a separate set of algorithms. However, studies have shown that HCWs' adherence to IMCI-recommended treatment has been low: previous reports described that severely ill children requiring referral were often missed or were not referred^{8,9}; a recent systematic review based on studies from 23 countries showed that only two-thirds of ill children received IMCI-recommended treatment despite being seen by an IMCI-trained HCW.¹⁰ Household survey data from Malawi from 2008 to 2012 showed that 69% of children with diarrhea received recommended treatment with oral rehydration salts (ORS), and only 30% of those with suspected pneumonia received recommended antibiotic treatment.¹¹

Few studies have assessed quality of facility-based IMCI care for pneumonia and diarrhea in Malawi, and recent surveys had relatively small sample sizes.^{12,13} We describe the current facility-based HCW practices in Malawi for the management of pneumonia and diarrhea among children < 5 years of age and examine factors associated with appropriate case management, using local IMCI guidelines as the gold standard. By understanding the factors associated with case management quality, more effective strategies to improve quality can be developed.

METHODS

Study setting. In Malawi, approximately 90% of health-care services are delivered through health facilities managed

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by the Ministry of Health (MoH) and the Christian Health Association of Malawi (CHAM).¹⁴ MoH facilities provide services free of charge; CHAM facilities follow MoH guidelines and charge a small fee for services. MoH and CHAM facilities provide a package of essential health services.¹⁵ Community hospitals (also known as rural hospitals) and district hospitals provide both primary and secondary care with admission capacity, and district hospitals also serve as referral hospitals.¹⁵ Malawi has been challenged with severe shortages of HCWs. With one physician per approximately 53,000 population (as of 2009),¹⁶ much of the clinical work in primary and secondary health facilities is performed by midlevel cadres, including medical assistants, who undergo 2 years of formal training and 1 year of internship, and clinical officers, who undergo 3 years of formal training and 1 year of internship.¹⁷

Although updated Malawi IMCI guidelines were published in December 2013, the last nationwide training for HCWs took place in 2009–2010. Due to limited funding, only seven of Malawi's 28 districts, including Chikwawa, one of the districts in our survey, received IMCI refresher training in 2014. In addition to IMCI training, a nationwide training for all HCWs on provision of zinc as part of diarrhea management took place in 2011–2012. This was in response to a revised national strategy that was developed in 2009 and 2010 to prevent more than 25,000 child deaths per year by using zinc to treat and prevent diarrhea.¹⁸ HCW training on acute respiratory illness (ARI) last took place in 2012–2013 in nine districts, including three (Chikwawa, Nsanje, and Phalombe) that were included in our study; however, no further training has been conducted due to lack of funding.

Sampling and survey population. From January to March 2015 (rainy season), we conducted a cross-sectional survey of health facilities in seven districts (Blantyre, Chikwawa, Chiradzuku, Mulanje, Nsanje, Phalombe, and Thyolo) in southern Malawi. The survey collected baseline data for a cluster-randomized, controlled trial to evaluate the effectiveness of mobile phone text-message reminders to HCWs to improve the case management of malaria, pneumonia, and diarrhea (NCT02645513).¹⁹ Analysis on malaria case management from this same survey is discussed in detail elsewhere.²⁰ We included health facilities operated by the MoH or CHAM if they had an outpatient department (OPD) that provided clinical care for ill patients, with a target of 105 facilities based on the sample size requirement of the text-message trial. During the survey, six facilities in Chikwawa and Nsanje could not be accessed due to poor road conditions during the rainy season and were therefore replaced by six facilities from Phalombe District. For facilities with more than one OPD, one was randomly selected (although most facilities had only one OPD), and a systematic random sample was taken of patients presenting to the selected OPD on the day of the survey team's visit during regular working hours (8 AM–4 PM). The sampling interval was based on expected patient volume and defined to yield approximately 20 interviewed patients per selected OPD.

We collected data with three instruments: patient exit interviews, HCW interviews, and health facility assessments. Patients were eligible for the exit interview if they were visiting the facility to see the HCW for the first time for the current illness. After sampled eligible patients (or their caregivers) provided written, informed consent to participate, they were given a study card to present to HCWs for

recording their diagnoses. Enrolled patients proceeded to be seen by the HCW at the selected OPD, then visited the laboratory and/or pharmacy, if relevant, and were interviewed by the survey team before exiting the facility. The survey team interviewed patients/caregivers about their symptoms, clinical encounter, laboratory tests done, and drugs prescribed or dispensed. Patients/caregivers were first asked about which symptoms they spontaneously reported to the HCW and then asked specifically about presence of key symptoms. The study team also reviewed patients' health passports, in which HCWs document symptoms, diagnoses, and treatment of every health-care visit. Then the survey team asked patients/caregivers about their diagnoses and clinical management including hospital referral, to elicit information that might not have been documented in the passport. All patients had their axillary temperature measured. In addition, all children with complaints of cough or difficult breathing had their respiratory rate measured by the survey team, and signs and symptoms of dehydration were assessed for all children with diarrhea. If patients were not managed at the health facility according to the national guidelines, appropriate treatment was given by the survey team without charge.

HCWs providing clinical consultations in the selected OPD on the day of the visit were interviewed at the end of the day about their training, work experience, supervision, and access to reference materials. To assess HCWs' knowledge on management of children with fever, respiratory symptoms and diarrhea, they were also asked to complete multiple-choice questions on nine clinical scenarios. Of the nine scenarios, we scored HCWs based on the four questions pertaining to assessment and management of a child with cough, difficult breathing, or diarrhea (Supplemental File). At the end of the day, the survey team conducted a health facility assessment through interviews with the facility in-charge and direct observations to assess facility infrastructure, staffing, stocks of basic medications, and availability of diagnostic tools and national reference materials. Survey teams were composed of four clinicians who underwent an 8-day training. Data collection took place from January 22 to March 5, 2015, using ASUS Nexus 7 Android Tablets (Taipei, Taiwan), which were programmed with skip patterns and logic checks using the CommCare mobile platform by Dimagi (Cambridge, MA).

Outcome definitions. Case definitions for "pneumonia," "severe pneumonia," "uncomplicated diarrhea," "severe diarrhea," and "recommended treatment" are described in Table 1. Cotrimoxazole is no longer recommended in the latest local IMCI material issued in 2013 nor in the latest WHO IMCI reference material,⁷ but as Malawi had limited training on the latest IMCI, cotrimoxazole was considered as one of the recommended antibiotic selections for pneumonia. Our primary outcomes for multivariable modeling were recommended treatment of pneumonia and uncomplicated diarrhea.

Statistical analysis. All three data sources (patient exit interview, HCW interview, and health facility assessment) were merged and linked to a patient visit. For this analysis, only visits by patients < 5 years of age were included. Frequencies and cross-tabulations were calculated. We used the SAS SURVEYFREQ procedure to estimate weighted proportions and 95% confidence intervals for patient-level outcomes but not for health facility and HCW-level outcomes. This procedure accounts for clustering at the health facility

TABLE 1
Outcome case definitions used for the survey

Outcome	Definition
Diagnosis	
Pneumonia	Cough or difficult breathing along with fast breathing, according to the survey team—measured respiratory rate, in children 2–59 months of age without general danger signs*
Severe pneumonia	Cough or difficult breathing in a child who also had any general danger signs*, chest indrawing, or stridor. Presence of indrawing or stridor was assessed by the survey team. Children < 2 months of age were not included in the pneumonia definitions, which only pertain to children 2–59 months of age in IMCI.
Uncomplicated diarrhea	Acute diarrhea with some or no dehydration per local IMCI guidelines in children < 5 years of age without danger signs.*† Presence of dehydration was assessed by the survey team.
Severe diarrhea	Acute diarrhea with danger signs*† or severe dehydration per local IMCI guidelines in children < 5 years of age. Presence of severe dehydration was assessed by the survey team.
Recommended treatment	
Pneumonia	HCW followed local IMCI guidance to administer, dispense, or prescribe: cotrimoxazole,‡ amoxicillin, or erythromycin for children with pneumonia, regardless of dose.
Uncomplicated diarrhea	HCW administered, dispensed, or prescribed ORS and zinc for children 2–59 months of age with diarrhea; and ORS only for children with uncomplicated diarrhea < 2 months of age, regardless of dose.

HCW = health-care worker; IMCI = integrated management of childhood illness; ORS = oral rehydration salts.

*Unable to drink or breastfeed, vomiting everything, lethargic or unconscious, or history of convulsions in children 2–59 months of age.

†For children < 2 months of age: not feeding well, convulsions, fast breathing (≥ 60 breaths per minute), severe chest indrawing, grunting, fever ($\geq 37.5^\circ\text{C}$), low body temperature ($< 35.5^\circ\text{C}$), or movement only when stimulated or no movement at all.

‡Cotrimoxazole is no longer recommended in the latest local IMCI material issued in 2013, but as Malawi had limited training on the latest IMCI, cotrimoxazole was considered as one of the recommended antibiotic selections for pneumonia.

level, and the weighting accounts for OPD and patient sampling probabilities and nonresponse. For logistic regression modeling (described below), we similarly used the SAS SURVEYLOGISTIC procedure. All analyses were conducted in SAS 9.3 (SAS Institute, Inc., Cary, NC).

HCWs' assessment, diagnosis, and treatment practices (based on information documented on the study card, patient health passport, or caregivers' report during the exit interview), were compared with the survey team's assessment from all information collected and examinations performed during the exit interview. For clinical scenarios, one point was given for each correct response based on national guidelines, with a maximum score of four. We examined the relationship of our primary outcomes of correct pneumonia and uncomplicated diarrhea treatment with variables at patient, HCW, and health facility levels, first using univariable and then multivariable logistic regression analyses. Predictor variables were selected based on knowledge from the literature as well as on the plausibility of effects. We included variables in the base multivariable model if $P < 0.1$ in univariable analysis. Variables with $P \geq 0.1$ were assessed for confounding by ascending order of their P value in univariable analysis. Statistical interactions were not explored due to the relatively small number of observed primary outcomes. Variables were retained in the model as confounders if their inclusion in the model changed the odds ratio (OR) of any other variable by $\geq 20\%$, except if the originally included variables were not initially significant at the $P < 0.05$ level and remained nonsignificant after the addition of the potential confounder. Added variables were also kept in the model as predictors if they were significant at the $P < 0.05$ level when they were added to the multivariable model. Every time a variable was added, the model was assessed for collinearity and variables were removed if warranted.

Ethical approval. We obtained written informed consent from all enrolled patients/caregivers and HCWs, prior to interviewing them. The study protocol for the mobile phone text-message study, which includes this baseline survey, was reviewed and approved by the Malawi College of Medicine

Ethical Committee and the Centers for Disease Control and Prevention (approval number 6550).

RESULTS

Among the 105 facilities surveyed, teams enrolled children < 5 years of age at 95 health facilities. At the 95 health facilities, the survey team interviewed 114 of 116 (98.3%) HCWs, and completed exit interviews on 723 of 725 (99.7%) enrolled children; two children were too sick for the exit interview to be completed.

Most (74.7%) children whose caregivers completed the exit interview were 12–59 months of age, and only 29 (3.9%) were < 2 months of age (Table 2). The majority (77.2%) presented with fever, followed by cough or difficult breathing (37.1%) and diarrhea (30.1%). About half (53.3%) of children were given malaria diagnosis by the HCW, and one-third of children received more than one diagnosis. Almost all interviewed caregivers (99.8%) carried their child's health passports.

Nearly three-quarters (73.7%) of HCWs who provided care to enrolled children were male, and most (74.1%) were medical assistants (Table 3). Approximately one-third (32.5%) reported ever attending training on IMCI (of whom 59.5% reported training duration of ≤ 5 days), whereas 79.0% reported ever attending in-service training on malaria case management. Only 3.5% of the HCWs had the national reference material for ARI available at the time of the survey; 16.7% had IMCI reference materials; and 47.4% had malaria treatment reference materials available. Among 109 (95.6%) of 114 HCWs who completed the clinical scenarios, the median score was 3 (of 4), with an interquartile range of 3–4.

Most facilities surveyed (89.5%) were health centers, and were operated by the MoH (79.0%) (Table 4). There were typically ≤ 2 HCWs working in the sampled OPD, and the number of patient visits per day the week before the survey ranged from nine to 400 (median 98). More than two-thirds of facilities reported having weighing scales (hanging weighing scale, infant scale, standing scale) and access to drinking water. Access to a functioning thermometer, electricity, and supplies for administering oral medications was

TABLE 2

Characteristics of children < 5 years of age enrolled in the survey and diagnoses given by HCWs, southern Malawi, January–March 2015 (N = 723)

Characteristics	N	Weighted* %	95% CI
Age in months			
< 2 months	29	3.9	2.1–5.7
2–11 months	160	21.5	18.2–24.7
12–59 months	534	74.7	71.0–78.3
Male	366	50.0	46.4–53.5
Sought care at another facility prior to this visit	28	2.8	1.4–4.1
Presenting complaints spontaneously reported by caregivers to HCWs†			
Fever	522	77.2	73.2–81.1
Cough or difficult breathing	273	37.1	31.7–42.5
Diarrhea	231	30.1	24.1–36.0
Vomiting	150	21.5	18.1–25.0
Skin problem	84	10.4	7.4–13.4
Stomach ache	61	9.0	6.0–12.0
Malaria	58	8.3	5.1–11.5
Chills	45	7.9	3.9–11.8
Weakness	16	3.1	1.0–5.2
Signs consistent with general danger signs‡	5	0.5	0–0.5
Others	143	17.4	13.4–21.5
Diagnoses given by HCWs§			
Malaria	338	53.3	44.8–61.8
Diarrhea	158	21.1	16.1–26.0
Acute respiratory illness	154	20.0	15.6–24.5
Sepsis	87	10.6	6.3–14.8
Pneumonia	64	8.9	4.2–13.5
Skin problem	57	6.6	4.4–8.7
Dysentery	23	3.0	1.2–4.8
Others	79	11.2	7.6–14.9
No diagnosis given	9	2.2	0.05–4.4
Number of diagnoses given by HCWs			
0	9	2.2	0.05–4.4
1	483	64.6	57.8–71.5
2	203	28.3	21.0–35.6
3	27	4.7	2.2–7.2
4	1	0.2	0–0.6

CI = confidence interval; HCW = health-care worker.

*Accounts for outpatient department and patient sampling probabilities and nonresponse. The analysis also accounts for clustering at the health facility level.

†Patients can present with more than one presenting signs or symptoms.

‡Includes any one of the following: history of convulsions, vomiting everything, unable to drink or breastfeed, lethargic or unconscious.

§More than one diagnoses can be given by HCWs.

||Any of the diagnoses classified as “others” were counted as one diagnosis, regardless of the number of diagnoses in that category.

TABLE 3

Demographics and training of HCWs who provided outpatient care at surveyed facilities in southern Malawi, January–March 2015 (N = 114)*

Characteristic	N	%
Median age in years (range)	–	29 (21–75)
Sex		
Male	84	73.7
Female	30	26.3
Cadre		
Clinical officer	12	10.7
Medical assistant	83	74.1
Nurse†	15	13.4
Other	2	1.8
Median years of formal health professional training (range)	–	2 (1–6)
Ever attended IMCI training	37	32.5
Median year attending IMCI training (range)	–	2009 (2005–2014)
Median number of days of training (range)	–	5 (3–14)
5 days or less	22	59.5§
More than 5 days	15	40.5§
Ever attended in-service training on malaria case management	90	79.0
Median year attending malaria training (range)	–	2014 (2005–2015)
Median number of days of training (range)	–	4 (1–14)
Access‡ to national reference materials		
ARI reference material	4	3.5
IMCI reference material	19	16.7
Malaria reference material	54	47.4
Supervision		
Had supervisory visit(s) in the past 6 months	76	66.7
Had visit with observation of patient consultations included	44	38.6
Had visit with observation that included counseling on pneumonia treatment	15	13.2
Had visit with observation that included counseling on diarrhea treatment	20	17.5
Median score of clinical scenarios (Q1–Q3), full score = 4	–	3 (3–4)

ARI = acute respiratory illness; HCW = health-care worker; IMCI = integrated management of childhood illness.

*116 HCWs saw enrolled children but two did not complete the HCW interview.

†Includes a registered nurse (bachelor's degree holder with 4 years of training), enrolled nurse (certificate or diploma holder with 2–3 years of training), and nurse midwife technician (diploma holder with 2 years of training).

‡HCW was able to show the reference materials to the survey team.

§Of the 37 HCWs who attended IMCI training.

||Five HCWs did not complete the clinical scenarios.

present in nearly two-thirds of facilities (65.3%, 64.2%, and 63.2%, respectively). Only 12.6% of facilities reported having a functioning timer available for counting respiratory rate (Table 4). All 95 facilities had at least one of the IMCI-recommended antibiotics for pneumonia in stock for the full day of the survey (67.4% for amoxicillin, 71.6% for erythromycin, and 99.0% for cotrimoxazole). Injectable penicillin, a recommended prereferral antibiotic for children with severe pneumonia, was available in only 51.6% of the facilities. ORS was available in more than 90.5% of the facilities. Information on stocks of zinc was not collected.

Among 694 children 2–59 months of age, HCWs ascertained cough or difficult breathing in 342 (48.0%) (Table 5). The survey team identified 352 (50.8%) children with cough or difficult breathing, and HCWs measured respiratory rate, an assessment recommended in IMCI for children with cough or difficult breathing, in eight (1.8%) of them. Altogether, 132 children (19.0%) met the survey criteria for pneumonia, and HCWs gave recommended treatment to 90 (68.2%), and recorded

a diagnosis of pneumonia for only 24 (18.2%). Antibiotic dosing information was available for 81 of the 90 (92.9%) children treated for pneumonia. Antibiotics were correctly dosed in 38 of the 81 (47.7%) children, and were underdosed in 42 (49.8%). One child (2.4%) received 7 days of recommended antibiotics instead of the recommended 5 days (Supplemental Table 1).

Among 108 children who did not receive a pneumonia diagnosis despite meeting the survey criteria for pneumonia, 69 (63.9%) received recommended treatment (Table 5). Diagnoses given to these 108 children included malaria (55.6%), including 33.6% with a documented positive malaria rapid diagnostic test (RDT) result, ARI (37.0%), diarrhea or dysentery (20.4%), and sepsis (13.0%). In the 42 children with survey-defined pneumonia who did not

TABLE 4
Characteristics of facilities included in the study (N = 95)

Characteristic	N	%
Type of health facility		
District hospital	2	2.1
Health center	85	89.5
Community/rural hospital	8	8.4
Operator		
Ministry of Health	75	79.0
CHAM	20	21.1
Median number of HCW performing outpatient consultation at the facility (range)	—	2 (1–16)
Daily outpatient volume 1 week prior to the survey*		
Median (range)	—	98 (9–400)
0–50	28	29.5
51–100	27	28.4
101–150	21	22.1
> 150	19	20.0
Facility infrastructure and availability of supplies		
Functioning hanging weighing scale available	79	83.2
Functioning infant scale available	73	76.8
Functioning standing scale available	73	76.8
Functioning thermometer available	62	65.3
Functioning timer for counting respiratory rate available	12	12.6
Electricity available	61	64.2
Water source available	79	83.2
Drinking water available	84	88.4
Supplies for administering oral medications available	60	63.2
Medication in stock for the full day		
Cotrimoxazole	94	99.0
Erythromycin	68	71.6
Amoxicillin	64	67.4
Any antibiotic for pneumonia treatment†	95	100.0
Penicillin	49	51.6
ORS	86	90.5

CHAM = Christian Health Association of Malawi; HCW = health-care worker; ORS = oral rehydration salts.

*For the outpatient department selected for the survey.

†One of the following: cotrimoxazole, amoxicillin, erythromycin. Cotrimoxazole is no longer recommended in the latest local integrated management of childhood illness (IMCI) material issued in 2013, but as Malawi had limited training on the latest IMCI, cotrimoxazole was considered as one of the recommended antibiotic selections for pneumonia.

receive recommended treatment, the most common diagnoses were malaria (69.0%, with 59.4% having a positive RDT), followed by diarrhea or dysentery (28.6%), pneumonia (7.1%), and sepsis (7.1%).

Fifteen of 694 (2.2%) children met IMCI criteria for severe pneumonia. Only one of the 15 (5.2%) were referred or admitted to a hospital per IMCI recommendations, and three (10.9%) received the recommended prereferral injectable penicillin.

HCWs assessed for presence of diarrhea in 328 (45.4%) of 723 children < 5 years (Table 6). There were 222 children who met our case definition for uncomplicated diarrhea; HCWs diagnosed diarrhea in 128 (57.7%) and gave recommended treatment to 94 (42.3%). ORS was given to 143 (63.3%) children, with or without zinc. Among the 94 children who did not receive a diarrhea diagnosis despite meeting the survey criteria for uncomplicated diarrhea, 22 (23.4%) still received recommended treatment of diarrhea. The most common diagnosis given to this group of children was malaria (56.4%), followed by ARI (18.1%) and sepsis (13.8%). Among the 128 children with surveyor-defined uncomplicated diarrhea but who did not receive recommended treatment, the most

common diagnosis given was malaria (57.0%), followed by diarrhea (43.8%).

Seventeen children (2.4%) met the survey criteria for severe diarrhea. Only one of these children (5.9%) was immediately referred or hospitalized, per IMCI recommendations.

Factors associated with correct pneumonia treatment of the 132 children meeting IMCI criteria for pneumonia are shown in Table 7. Of note, no health facility characteristics were included in the final multivariable logistic regression model because these characteristics were not associated with recommended treatment in the univariable analysis ($P \geq 0.1$), and none of these variables showed evidence of confounding. Results from the final multivariable model show that caregivers' spontaneous report of cough or difficult breathing was associated with increased odds of receiving correct pneumonia treatment (OR: 2.8, $P = 0.023$), whereas an HCW diagnosis of malaria was negatively associated with recommended treatment (OR: 0.5, $P = 0.046$). There was a non-significant association of IMCI training with recommended treatment (OR: 2.7, $P = 0.093$). Access to IMCI reference materials (OR: 1.3, $P = 0.601$) was not associated with correct pneumonia treatment in the univariable analysis.

Table 8 summarizes factors associated with correct diarrhea treatment of the 222 children < 5 years of age meeting criteria for uncomplicated diarrhea. Results from the final multivariable model show that male patient sex (OR: 0.4, $P = 0.016$) and HCW diagnosis of malaria (OR: 0.3, $P = 0.003$) had negative association with recommended treatment of diarrhea, whereas caregivers' spontaneous report of diarrhea (OR: 24.2, $P < 0.001$), HCW access to IMCI reference materials (OR: 4.4, $P = 0.025$), and having stock of ORS for the full day on the day of the survey (OR: 4.0, $P = 0.005$) were associated with increased odds of receiving recommended treatment. Neither supervision (OR: 0.7, $P = 0.356$) nor IMCI training (OR: 1.0, $P = 0.986$) were associated with correct diarrhea treatment in the univariable analysis.

DISCUSSION

Our results show that many children < 5 years of age in southern Malawi were not managed for pneumonia and diarrhea according to local IMCI guidelines: fewer than half of the children in our survey were assessed for signs and symptoms of pneumonia and diarrhea, and respiratory rate was assessed in only 2.0% of children with cough or difficult breathing.⁷ In addition, only about two-thirds of children meeting the survey definition of pneumonia and fewer than half of the children with diarrhea received IMCI-recommended treatment. When antibiotic dosing was taken into account, less than half of the children with pneumonia were given recommended treatment. Household survey results from 2005 to 2012 from 39 countries (including Malawi) that account for 80% of the world's pneumonia and diarrhea deaths also showed that many children were not managed appropriately: among countries that reported data, just about half (range 7–88%) of children suspected of pneumonia received antibiotics, one-third (out of range 11–78%) of children with diarrhea received ORS, and < 1% (range 0.1–19.3%) of children with diarrhea received zinc.²¹ These findings are concerning, considering that treatments for pneumonia and diarrhea are safe, inexpensive, and effective²¹; yet every year, more than two million children die of these two diseases together, globally.¹ Adherence to IMCI

TABLE 5

Assessment of cough or difficult breathing and management of pneumonia in children 2–59 months of age, southern Malawi, January–March, 2015

Characteristic	N	Weighted* %	95% CI
Surveyor assessment	N = 694		
Cough or difficult breathing present (1)	352	50.8	47.1–54.5
Meets pneumonia† definition (2)	132	19.0	16.1–22.0
Meets severe pneumonia‡ definition (3)	15	2.2	1.1–3.3
HCW assessment of cough or difficult breathing	N = 694		
Cough or difficult breathing spontaneously reported by caregiver (4)	257	36.1	30.6–41.5
HCW documented presence of cough or difficult breathing (5)	234	33.3	28.9–37.7
HCW asked about cough or difficult breathing§ (6)	58	12.6	7.9–17.3
HCW ascertained cough or difficult breathing (7) [(4), (5), or (6)]	342	48.0	43.1–52.8
Respiratory rate measured among (1)	n/N 8/352	1.8	0.0–3.6
Respiratory rate measured among (7)	9/342	2.0	0.1–3.8
Assessment and management of children with pneumonia† [= (2)]	N = 132		
Pneumonia diagnosed by HCW	24	18.2	10.8–25.6
Recommended treatment given	90	68.2	60.3–76.0
Management of children with severe pneumonia‡ [= (3)]	N = 15		
Referred for immediate hospitalization	1	5.2	0–15.6
Injectable penicillin administered	3	10.9	0–24.3
HCW diagnoses given to children with surveyor-assessed pneumonia† but not receiving pneumonia diagnoses¶	N = 108		
Malaria	60	55.6	45.5–65.6
RDT tested	44	42.6	27.7–57.5
RDT confirmed	38	33.6	20.2–47.0
Acute respiratory illness	40	37.0	28.2–45.8
Diarrhea or dysentery	22	20.4	11.8–28.9
Sepsis	14	13.0	6.0–20.0
Skin problem	6	5.6	1.3–9.8
Eye infection	4	3.7	0.2–7.2
Ear infection	2	1.9	0–4.4
Recommended treatment given	69	63.9	54.7–73.1
HCW diagnoses¶ given to children with surveyor-assessed pneumonia† who did not receive recommended treatment	N = 42		
Malaria	29	69.0	56.4–81.7
RDT tested	24	62.8	44.5–81.1
RDT confirmed	22	59.4	40.2–78.6
Diarrhea or dysentery	12	28.6	15.1–42.1
Pneumonia	3	7.1	0–15.2
Sepsis	3	7.1	0–15.0
Acute respiratory illness	3	7.1	0–14.8
Cough or cold	2	4.8	0–11.4
Eye infection	2	4.8	0–11.4

CI = confidence interval; HCW = health-care worker; IMCI = integrated management of childhood illness; RDT = rapid diagnostic test.

*Accounts for outpatient department and patient sampling probabilities and nonresponse. The analysis also accounts for clustering at the health facility level.

†Defined according to local IMCI criteria for pneumonia (presence of cough/difficult breathing and fast breathing measured during exit interview) without general danger signs (unable to drink or breastfeed, vomiting everything, lethargic or unconscious, history of convulsions) and without chest indrawing or stridor.

‡Cough or difficult breathing in a child who also had any general danger signs, or surveyor-assessed chest indrawing or stridor. Local IMCI recommends that the child should be urgently referred to a hospital after giving a dose of benzylpenicillin.

§If presence of cough or difficult breathing in the child was not spontaneously reported by the caregiver during the exit interview, or was not documented by the HCW, then the survey team asked the caregiver if the HCW asked about presence of cough or difficult breathing in the child.

||Recommended treatment is defined as cotrimoxazole, amoxicillin, or erythromycin administered, dispensed, or prescribed by the HCW for those meeting the criteria for pneumonia.

¶A patient can have more than one diagnosis.

recommendations in children with severe conditions was even lower in our study.

There are several possible explanations for low adherence to IMCI guidelines. First is lack of recent IMCI training. Our study results showed that only one-third of interviewed HCWs received IMCI training, and according to the Malawian MoH, IMCI training had not occurred since 2009–2010 for most districts due to financial constraints.

However, it has also been well documented that IMCI training alone does not improve adherence to IMCI,^{9,10,22} and this could explain why IMCI training was not significantly associated with recommended treatment in our analysis. Results from an ongoing systematic review showed that a combination of “high-intensity” training (i.e., duration > 5 days or ongoing training and at least one interactive educational method) and supervision was a relatively effective way to

improve HCW performance (Rowe and others, unpublished data). In our survey, 60% of the IMCI-trained HCWs reported a training duration of < 5 days, with a limited number of follow-up supervisory visits due to lack of funding (H. Nsona, Malawian MoH, personal communication, April 19, 2016). Thus, lack of effective IMCI-related training and supervision could have resulted in the low adherence to guidelines.

Another possibility is that HCWs are managing patients based on a single diagnosis, rather than considering all potential comorbidities. This has also been previously described, particularly in the context of malaria overdiagnosis.^{8,23,24} In our study, HCWs’ diagnosis of malaria had negative associations with provision of recommended treatment of both pneumonia and uncomplicated diarrhea. Refresher training on malaria treatment, which does not cover other febrile illness, took place in the study area in Malawi in 2014,

TABLE 6
Diarrhea assessment and management in children < 5 years of age, southern Malawi, January–March, 2015

Characteristic	N	Weighted %*	95% CI
Survey assessment	N = 723		
Diarrhea present	272	37.7	34.1–41.3
Meets definition of uncomplicated diarrhea† (1)	222	30.7	27.4–34.1
Meets definition of severe diarrhea‡ (2)	17	2.4	1.2–3.5
HCW assessment of diarrhea	N = 723		
Diarrhea spontaneously reported by caregiver (3)	231	32.0	28.6–35.4
HCW documented presence of diarrhea (4)	194	26.9	23.4–30.3
HCW asked about diarrhea§ (5)	86	17.9	13.8–21.9
HCW ascertained diarrhea [(3), (4), or (5)]	328	45.4	41.1–49.6
HCW assessment and management of children with uncomplicated diarrhea [= (1)]	N = 222		
Diarrhea diagnosed by HCW	128	57.7	50.3–65.0
Recommended treatment given	94	42.3	34.7–49.9
ORS given, with or without zinc	143	63.3	55.9–70.6
HCW management of children with severe diarrhea‡ [= (2)]	N = 17		
Referred for immediate hospitalization	1	5.9	0–17.4
HCW diagnoses given to children with surveyor-assessed uncomplicated diarrhea† but not receiving diarrhea diagnoses	N = 94		
Malaria	53	56.4	46.3–66.5
RDT tested	41	43.6	32.6–54.6
RDT confirmed	38	40.4	29.3–51.5
Acute respiratory illness	17	18.1	9.8–26.4
Sepsis	13	13.8	6.6–21.1
Pneumonia	7	7.4	2.2–12.7
Dysentery	7	7.4	1.3–13.6
Skin problem	5	5.3	0.8–9.9
Recommended treatment given	22	23.4	14.4–32.5
HCW diagnoses given to children with surveyor-assessed uncomplicated diarrhea† but not receiving correct treatment	N = 128		
Malaria	73	57.0	46.5–67.6
RDT tested	47	36.7	24.7–48.8
RDT confirmed	43	33.6	21.7–45.5
Diarrhea	56	43.8	33.3–54.2
Upper respiratory illness	28	21.9	15.1–28.7
Sepsis	12	9.4	4.7–14.1
Skin problem	3	2.3	0–5.0
Eye infection	3	2.3	0–5.0
Ear infection	3	2.3	0–5.0

CI = confidence interval; HCW = health-care worker; IMCI = integrated management of childhood illness; ORS = oral rehydration salts; RDT = rapid diagnostic test.

*Accounts for outpatient department and patient sampling probabilities and nonresponse. The analysis also accounts for clustering at the health facility level.

†Defined as children < 5 years of age with acute diarrhea with some or no dehydration without general danger signs per local IMCI.

‡Defined as acute diarrhea with danger signs or with surveyor-assessed severe dehydration. Local IMCI recommends that the child should be referred urgently to a hospital if danger signs are present or if intravenous hydration is needed.

§If presence of diarrhea in the child was not spontaneously reported by the caregiver during the exit interview, or not documented by the HCW, then the survey team asked the caregiver if the HCW asked about presence of diarrhea in the child.

||Defined as ORS and zinc for children 2–59 months of age with diarrhea, and ORS only for children with diarrhea < 2 months of age.

and our results show that more HCWs had attended training on malaria treatment in recent years compared with IMCI training. Thus, it is possible that recent exposure to malaria treatment training and limited IMCI training could have facilitated the mindset among HCWs of finding a single diagnosis to explain patient symptoms. Previous qualitative research has examined factors associated with overdiagnosis of malaria among HCWs in Tanzania, and described “mindlines,” which are rationales influenced by initial training, peers, and perceived patient preferences that affected clinicians’ behavior, such as, “malaria is easier to diagnose than alternative diseases,” “malaria is a more acceptable diagnosis,” and “missing malaria is indefensible.”²⁴ In our study, having conducted the survey during the rainy season when malaria transmission is at its peak could also have contributed to malaria overdiagnosis.

Female patient sex, being treated by HCWs with access to IMCI reference materials, and being at a facility with ORS in stock were positively associated with correct diarrhea treatment. Although studies have reported that males have a higher risk of developing childhood diarrhea compared

with females,^{25–27} there were no differences in the proportion of males and females among children with diarrhea in our study (53.6% were male, 46.4% female, $P = 0.31$), and the reasons why females were more likely to receive recommended treatment are unclear. It is also unclear why access to IMCI reference materials was associated with correct diarrhea treatment, but not with correct pneumonia treatment. One possibility is that the need to measure respiratory rate among children with cough or difficult breathing made it less likely for HCWs to follow IMCI recommendations for pneumonia, even when the reference materials were available.

Our study is subject to several limitations. First, surveyors did not directly observe HCWs’ performance, and assessment of their actions was based on documentation by HCWs in patients’ passports and on caregivers’ reports to the survey team. Therefore, some of the HCWs’ assessments might have been missed, underreported, or misclassified. Second, presence of the survey team might have resulted in improved HCW performance, described as the Hawthorne effect,^{28,29} resulting in overestimation of adherence to IMCI.

TABLE 7
Predictors of recommended treatment among patients 2–59 months of age meeting criteria for uncomplicated pneumonia (*N* = 132)

Characteristic	<i>N</i>	Weighted % given recommended treatment*	Unadjusted odds ratio (95% CI)	<i>P</i> value	Adjusted odds ratio† (95% CI)	<i>P</i> value
Patient related						
Age group						
2–11 months	35	78.6	2.8 (0.95–8.0)	0.062	1.9 (0.6–6.0)	0.264
12–59 months	97	57.1	Referent		Referent	
Caregivers' spontaneous report of cough or difficult breathing						
Yes	95	70.2	4.0 (1.1–15.0)	0.005	2.8 (1.2–6.8)	0.023
No	37	36.9	Referent		Referent	
HCW related						
HCW diagnosis of malaria						
Yes	71	52.6	0.3 (0.1–0.7)	0.007	0.5 (0.2–0.99)	0.046
No	61	77.4	Referent		Referent	
Sex of HCW‡						
Male	102	57.5	0.4 (0.1–1.1)	0.085	0.5 (0.2–1.5)	0.242
Female	29	78.2	Referent		Referent	
HCW received IMCI-specific training‡						
Yes	34	76.0	2.3 (0.8–6.4)	0.109	2.7 (0.9–8.8)	0.093
No	97	57.9	Referent		Referent	

CI = confidence interval; HCW = health-care worker; IMCI = integrated management of childhood illness.

*Weighted percent of those who received recommended treatment within each subcategory. Accounts for outpatient department and patient sampling probabilities and nonresponse. The analysis also accounts for clustering at the health facility level.

†Confounding was tested for the following variables, but was found not to be present: sex of patient, presence of fever, respiratory rate measurement by HCW, years of experience caring for patients, supervisory visits in the last 6 months, years of formal training, access to a copy of IMCI guidelines, access to a copy of acute respiratory illness guidelines, number of patient visits per day at the selected outpatient department, functioning timer for counting respiratory rates, health facility operator.

‡Information missing from one HCW.

TABLE 8
Predictors of recommended treatment among patients < 5 years of age meeting criteria for uncomplicated diarrhea (*N* = 222)

Characteristic	<i>N</i>	Weighted % given recommended treatment*	Unadjusted odds ratio (95% CI)	<i>P</i> value	Adjusted odds ratio† (95% CI)	<i>P</i> value
Patient related						
Age group						
0–11 months	61	50.3	2.0 (0.9–4.2)	0.083	1.3 (0.6–3.2)	0.500
12–59 months	161	34.2	Referent		Referent	
Sex						
Male	119	30.7	0.5 (0.3–0.9)	0.025	0.4 (0.2–0.8)	0.016
Female	103	47.4	Referent		Referent	
Caregivers' spontaneous report of diarrhea						
Yes	187	43.3	12.5 (3.3–46.9)	< 0.001	24.2 (6.0–97.0)	< 0.001
No	35	5.8	Referent		Referent	
Presence of fever						
Yes	182	33.8	0.3 (0.1–0.7)	0.005	0.4 (0.1–1.3)	0.132
No	40	62.0	Referent		Referent	
HCW related						
HCW diagnosis of malaria						
Yes	103	23.7	0.3 (0.1–0.5)	< 0.001	0.3 (0.1–0.6)	0.003
No	119	54.7	Referent		Referent	
Type of clinician§						
Clinical officer	15	25.5	Referent		Referent	
Medical assistant	177	38.0	1.8 (0.4–7.8)	0.018	1.0 (0.1–8.3)	0.248
Nurse	18	41.7	2.1 (0.3–13.0)		0.3 (0.02–3.8)	
Others	11	62.0	4.8 (1.1–21.7)		3.3 (0.3–37.7)	
IMCI reference material available§						
Yes	26	66.5	3.6 (1.3–10.2)	0.015	4.4 (1.2–16.3)	0.025
No	195	35.3	Referent		Referent	
Health facility related						
Health facility operator						
MoH	189	36.7	0.4 (0.2–1.2)	0.106	0.2 (0.05–1.1)	0.071
CHAM	33	57.1	Referent		Referent	
Stock of ORS available for the full day						
Yes	202	40.5	2.3 (0.9–5.7)	0.073	4.0 (1.5–10.2)	0.005
No	20	22.9	Referent		Referent	

CHAM = Christian Health Association of Malawi; CI = confidence interval; HCW = health-care worker; IMCI = integrated management of childhood illness; ORS = oral rehydration salts.

*Weighted percent of those who received recommended treatment within each subcategory. Accounts for outpatient department (OPD) and patient sampling probabilities and nonresponse. The analysis also accounts for clustering at the health facility level.

†Confounding was tested for the following variables, but was found not to be present: number of patient visits per day at the selected OPD, years of formal health professional training, years of experience caring for patients, sex of health worker, health facility type, ever attended IMCI training, number of diagnoses given by the HCW, supervisory visits in the last 6 months.

‡Information missing from one HCW.

Nevertheless, many children with pneumonia or diarrhea were not managed correctly according to the local IMCI guidelines. Third, our analysis might have been underpowered to assess certain factors associated with correct pneumonia and diarrhea treatment. Our analysis used a subset of survey data collected for the cluster-randomized controlled trial, for which the sample size calculation was based on patients of all ages, not only children. As a result, we only have a limited number of children under 2 months of age. Lastly, there is a possibility of residual confounding and additional relevant explanatory associations that were missed due to unmeasured factors. Some of these might include HCWs' attitudes and beliefs toward IMCI. In in-depth interviews conducted with HCWs in Tanzania, interviewed HCWs expressed little need to follow IMCI guidelines; lack of motivation due to working in an unsatisfactory work environment, lack of appreciation and feedback, and little monetary remuneration; and perceptions that IMCI is time consuming.³⁰ Another study from Tanzania reported that HCWs do not see the need to refer all severely ill children as recommended in IMCI.⁸ The high scores in our study on the pneumonia- and diarrhea-related clinical scenarios suggest that HCWs might actually possess the knowledge of IMCI guidelines but may not be putting their knowledge into practice.

Compared with other studies that looked at facility-based IMCI pneumonia and diarrhea management in Malawi,^{12,13} our study includes a larger number of health facilities and HCWs. Thus, we believe that our survey results provide a detailed, more comprehensive description of the current quality of facility-based IMCI pneumonia and diarrhea management by HCWs in Malawi. To improve quality of care, our study suggests that HCWs should be encouraged to systematically and thoroughly assess sick children for all IMCI signs and symptoms, even when malaria is suspected. Particular emphasis should be placed on diagnosis and treatment of severe pneumonia and diarrhea and children, which can lead to death if not treated properly. In support of this, a renewed effort is needed to invest in IMCI in-service training for HCWs, regular follow-up supervision, and monitoring HCW performance. Performance monitoring results could be used to assess progress and, if needed, select and evaluate additional strategies to improve HCW performance (e.g., collaborative improvement,^{31,32} mHealth strategies,^{33,34} and incentives^{35,36}). Results from the text-messaging study might provide insights into whether regular text-message reminders about case management guidelines might be effective.

In conclusion, our results show that many children < 5 years of age in southern Malawi with pneumonia or diarrhea were not consistently managed according to local IMCI guidelines, especially when malaria was suspected by HCWs. Limited IMCI training and supervision had taken place in recent years, and renewed efforts and resources to invigorate the IMCI strategy in Malawi are needed.

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