Health system challenges for improved childhood pneumonia case management in Lagos and Jigawa, Nigeria

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Abstract

Background

Case fatality rates for childhood pneumonia in Nigeria remain high. There is clear need for improved case management of pneumonia, through sustainable implementation of the Integrated Management of Childhood Illnesses (IMCI) diagnostic and treatment algorithms. We explored barriers and opportunities for improved case management of childhood pneumonia in Lagos and Jigawa states, Nigeria.

Methods

A mixed-method analysis was conducted to assess the current health system capacity to deliver quality care. This was done through audits of 16 facilities in Jigawa and 14 facilities in Lagos, questionnaires (n=164) and 13 focus group discussions with providers. Field observations provided context for data analysis and triangulation.

Results

There were more private providers in Lagos (4/8 secondary facilities) and more government providers in Jigawa (4/8 primary, 3/3 secondary and 1/1 tertiary facilities). Oxygen and pulse oximeters were available in 2/3 in Jigawa and 6/8 in Lagos of the sampled secondary care facilities. None of the 8 primary facilities surveyed in Jigawa had oxygen or pulse oximetry available while in Lagos 2/3 primary facilities had oxygen and 1/3 had pulse oximeters. Other IMCI and emergency equipment was also lacking including respiratory rate timers, particularly in Jigawa state. Healthcare providers scored poorly on knowledge of IMCI, though previous IMCI training was associated with better knowledge.

Key enabling factors in delivering paediatric care highlighted by healthcare providers included accountability procedures and feedback loops, the provision of free medication for children, and philanthropic acts. Common barriers to providing care included the burden of out-of-pocket payments, challenges in effective communication with caregivers, delayed presentation, and lack of clear diagnosis and case management guidelines.

Conclusion

There is an urgent need to improve how the prevention and treatment of paediatric pneumonia is directed in both Lagos and Jigawa. Priority areas for reducing paediatric pneumonia burden are training and mentoring of healthcare providers, community health education, and introduction of oximeters and oxygen supply.

Introduction

Despite the global intent to achieve the Sustainable Development Goal 3, mortality rates of children under five are still unacceptably high. [1] More than six million under-five children die each year, and pneumonia is the second leading cause of such deaths, with 880,000 deaths in 2016.[1] Half of these global deaths happen in only 5 countries, one of which is Nigeria.[1] The Nigerian under-five mortality rate was 100 (90% uncertainty interval: 72–138) deaths per 1,000 live births in 2017[2], considerably higher than the Sustainable Development Goal target of 25/1,000 live births which needs to be achieved by 2030. The mortality rate due to pneumonia specifically was reported as 19/1,000 in 2016, with the 'Global Action Plan for Pneumonia and Diarrhoea' target being 3/1,000 by 2025.[3] Nigeria is not on target to reach these goals, and a clear need has been identified for evidence-based and sustainable implementation of programmes targeted at childhood infections, and specifically pneumonia.[4]

Implementation of standardised guidelines, such as the WHO's Integrated Management of Childhood Illnesses (IMCI) has resulted in considerable reductions in pneumonia mortality.[5-7] However, these guidelines are often implemented poorly, and a lack of supportive supervision structures can lead to lapses in coverage. [8] At the community level, current WHO recommendations state that all children with fast breathing are classified as having "pneumonia" and treated with high dose oral amoxicillin, while children with chest-indrawing or danger-sign pneumonia should be referred to a higher level.[9] However, in situations where referral is not possible and if local health policy allows, CHWs may treat chest indrawing pneumonia with high dose oral amoxicillin, with dispersible amoxicillin being the preferred treatment for children.[9] At the health facility level, the WHO recommends that all children with fast breathing and/or chest indrawing are classified as having "pneumonia" and treated with high dose oral amoxicillin; the

recommended dosage is 80 mg/kg for five days (40 mg/ kg twice a day); in settings of low HIV prevalence the duration of treatment for 'fast breathing pneumonia' can be reduced to three days.[10] Children with cough/difficulty breathing and danger signs including low blood oxygen saturation should be classified as "severe pneumonia" and treated with oxygen.[10]

It is a policy in Nigeria to utilize standard guidelines, but policy adoption is on a state-by-state basis, with a plurality of systems, with government, private and traditional medicine all available. Furthermore, the oxygen policy document has been written[11], but it is unclear if it is being implemented in Nigeria. There is need to assess and document the enabling factors as well as the challenges in proper implementations of these policies in Nigeria.

This study aims to describe the current health system capacity, across different levels of care, to deliver quality care for paediatric pneumonia in Nigeria, using two states as case studies, to represent the diversity in cultural and economic contexts within Nigeria. This will provide information on the current barriers to effective pneumonia management, and therefore opportunities for intervention to lead to sustainable improvement.

Materials and Methods

Study design:

We conducted a concurrent mixed methods study in two states, Lagos and Jigawa, including: facility audits; healthcare provider surveys assessing their knowledge and practice; and healthcare provide focus group discussions (FGDs) to explore current practice and opportunities and barriers for quality care provision. Data was collected from November 2018 – June 2019.

Study setting:

The study was conducted in Jigawa and Lagos states. Jigawa, North West Nigeria, is a young state, created in 1991 by dividing from Kano state. Its total land area is around 22,410 km^2, predominately rural and with a population of 5.6 million.[12] The under-five population is 900,000 and the under-five mortality is very high at 192/1,000 live births.[13] There are 27 Local Government Areas (LGA) in the territory, and one tertiary hospital.[12,14] The burden of pneumonia in Jigawa is higher than the national average (19 deaths per 1,000 live births[15]), with an estimated 35 pneumonia deaths per 1,000 live births.[14] Jigawa's economy is agriculture based - with over 80% of the population working as farmers - and most of the population lives in rural areas.[16] Most of the population (69%) lives in severe poverty, with 50.3% belonging to the lowest wealth quintile (the highest proportion of any state in Nigeria).[13,16]

Lagos, South West Nigeria, by contrast is predominately urban or peri-urban, with a population of 21 million across an area of 3,474 km^2.[17] There are 3.4 million under-five children, and an under-five mortality rate of 50/1,000 live births.[13] There are twenty LGAs and three tertiary hospitals.[17,18] Considerably lower than Jigawa, the estimated under-five pneumonia mortality is 9/1,000 live births.[18] The economy of Lagos revolves around oil and petroleum and trade through

the Port of Lagos - one of the most important trading ports in Africa.[17] Only 1.1% of the population live in severe poverty, and 85.4% belong to the highest wealth quintile.[13,16]

Facility audits:

We took a case study approach to the selection of health facilities in each state, taking an in-depth look at the current capacity to deliver IMCI, considering staffing, infrastructure, equipment and drug supplies. This approach was chosen to ensure a range of facilities were represented, but being pragmatic in terms of project resources. A total of 16 health facilities in Lagos state and 16 health facilities in Jigawa state were targeted (Figure 1). We targeted more primary care facilities in Jigawa and more on private providers in Lagos, to reflect the differences in the distribution of facilities within these states. Where no facilities in a given category were located in the LGA, we included the nearest facility geographically to the LGA. Questions were asked and observations documented with regards to the supply and availability of IMCI drugs and equipment, oxygen, pulse oximetry, power source, power last 24 hours, water, opening times, housing/on-call rooms, staffing, wards and caseload (pneumonia admissions, referrals and deaths) (Web Appendix 1).

Audits were conducted by researchers (IA and FS) and an assistant, with the support of facility staff. Audits were conducted on a pre-arranged day, and required visual clarification and inspection of resources. One form was filled for the overall facility, and one form for each ward in the facility, which provided treatment to children aged 0-59 months, including inpatient and outpatient wards. Data were all collected on Android tablets using a custom-made form in the ODK Collect application. [19]

Healthcare provider questionnaires:

Healthcare providers, including doctors, nurses, community health extension workers (CHEWs), and qualified and unqualified pharmacists (known locally as Private Patent Medicine Vendors (PPMVs)), who provide care to children within the sampled facilities were eligible for recruitment. We used a convenience sampling approach, aiming to recruit all providers present at the facility at the time of the audit. The questionnaire (Web Appendix 2) focused on their knowledge of paediatric pneumonia, IMCI, emergency care, training and current clinical practice. Questionnaires were self-completed (for providers who were literate and could read and write in English) or administered by the researcher using Android Tablets.

Focus Group Discussions

A sub-sample of providers from targeted facilities were recruited to take part in FGDs. The facilities targeted for FGDs are highlighted in Figure 1, with a total of eight FGDs planned (one covering each of the four bordered boxes to the left of Figure 1, for each of Lagos and Jigawa states).

Topics discussed in the FGDs (Web Appendix 3) included understanding and management of pneumonia, barriers and enabling factors in treating pneumonia, and priorities for reducing burden. These discussions were held at facilities (or a nearby convenient location in the communities), and providers were grouped according to their training and facility type. FGDs were led by a researcher and an assistant, and all discussions were audio-recorded, transcribed and then translated to English for analysis. Group discussions took 60-90 minutes.

Analysis

The facility audit and survey data were described using proportions, means and ranges. Both were stratified by state and provider type and differences between strata were tested using chi^2 and t-test tests. The IMCI questions requiring more than one answer were scored using fractions where e.g. if 3 answers were required as in question 2.3 (Web Appendix 2) one third of a mark would be given for each correct answer and one third of a mark subtracted for each incorrect answer. The FGDs were analyzed using a pragmatic framework approach that blends inductive and deductive analytical approaches.[20] Pre-defined themes based on the topic guides guided an initial analysis, with any emerging themes coded during the analysis. All qualitative data were coded by CK, and interpretation shared with the research team for input. In addition, the researchers kept field diaries, in which they recorded their observations and key understandings of the context from informal conversations with community members, gate-keepers and healthcare providers. These notes were used to add context to the qualitative and quantitative data during triangulation to aid our interpretation of both sets of data.

Ethics

Ethical approval was granted by University College London (3433/002), University of Ibadan/University College Hospital Research Ethics Committee (UI/EC/19/0033), and the Ministry of Health in Lagos (LSMH/5869/140) and Jigawa (MOH/SEC3/S/738/I). Written informed consent was given by focus group discussion participants, and implied consent was given by survey respondents who were informed about the study before completing the survey.

Results

We surveyed 16 facilities in Kiyawa LGA in Jigawa state and 14 facilities in Ikorodu LGA in Lagos state including government and private, PPMVs, pharmacies, primary, secondary and tertiary facilities (Table 1). In Ikorodu LGA in Lagos there are no tertiary facilities and we were unable to survey Lagos State University Teaching Hospital (LAUTH), which serves the LGA as a tertiary referral center, because we were not able to obtain the necessary approval in time. There are also only two rather than four government secondary facilities, though we surveyed an additional private secondary facility, totaling eight rather than the targeted nine secondary facilities, and there were differences in available primary facilities as well (Figure 1). In Kiyawa LGA, and 2 pharmacy stores and 1 Tertiary facility were included from outside the LGA. We conducted eight FGD in Lagos (three with hospital-based health workers, three with health workers in primary care facilities and two with pharmacists); and five FGD in Jigawa (two with hospital-based health workers, one with health workers in primary care facilities and two with pharmacists).

All healthcare providers on duty at the time of the facility audit were asked to complete a questionnaire and 164 completed questionnaires were collected from a variety of health workers (Table 1) (response rate: ~90%; ~15 providers were unable to complete the survey due to high workload).

Healthcare provider knowledge

About the same proportion of healthcare providers in Lagos (35%) and Jigawa (34%) reported having training on IMCI. All cadres reported receiving IMCI training and at similar levels (doctors: 9/22 [41%], nurses/midwives: 31/94 [33%] and CHO/CHEW/Attendant 17/48 [35%])

suggesting that all cadres are offered IMCI training. The proportion of health workers in each facility type reporting training on IMCI was also similar (primary: 24/55 [44%], secondary: 30/92 [33%], tertiary: 3/9 [33%]), though none of the 6 PPMVs and 2 pharmacists surveyed reported being trained in IMCI. We asked respondents to complete 9 questions on IMCI knowledge. IMCI knowledge was poor in general and slightly worse in Jigawa than Lagos (mean: 3.9 vs. 4.3), though this was not statistically different (p=0.740). IMCI knowledge test scores were higher among those who reported receiving IMCI training in both Jigawa and Lagos, and in both states doctors generally scored better than nurses and midwives, who scored better than CHEWs and attendants (Table 2). In state-stratified multivariable regressions, the only statistically significant association in Jigawa was having received IMCI training (increase in IMCI Knowledge score of 0.71, 95% CI: 0.08, 1.33, p=0.028); and in Lagos was CHO/CHEW/Attendant job title (decrease in IMCI Knowledge score relative to doctor: -1.6, 95% CI: -2.5, -0.6, p=0.002).

For the IMCI questions, the most correct answers were given on the most common causes of child death (81% correct) and pneumonia classification (74% correct), while the worst was on recognising anaemia (9%) and what to counsel mothers on (21% correct).

In Lagos state, 40% of the respondents reported having oxygen training while in Jigawa only 13% reported this training. More (27%) healthcare workers in Lagos reported pulse oximetry training compared to those in Jigawa (9%). Of those who said they had pulse oximetry training 31% got the definition of hypoxemia correct compared to 19% of those who did not report pulse oximetry training; and of those reporting oxygen training 81% got the question on what oxygen flow to start an infant on correct, compared to 34% who did not report having oxygen training.

Current clinical practice:

Respondents in Jigawa reported seeing slightly more children per week on average (median: 38) than those in Lagos (median: 28), though in Lagos doctors reported seeing many more children per week compared to other cadres than was the case in Jigawa (Table 3). Respondents typically reported seeing very few (0-3) cases of "severe pneumonia" per week across states, job cadres and facility types; and few referrals per week were also reported (Table 3).

Pooling the data across all of the facilities in Jigawa we estimate a 1.0% case fatality rate for all under-5 cases (78 deaths in 7846 cases) and a 7.9% case fatality rate for ARI cases (24 deaths in 302 ARI cases) – assuming these diagnoses were correct (Table 4). Pooled data across all of the facilities in Lagos however shows a lower case fatality rate than in Jigawa: 0.5% for all under-5 cases (14 deaths in 2671 cases) and a 0% case fatality rate for ARI cases (0 deaths in 130 ARI cases) (Table 4).

Figure 2 breaks down health care provider reports of giving antibiotics for pneumonia by state, job cadre and facility type. Of the respondents, 40% (n=27) in Jigawa and 25% (n=24) in Lagos could correctly identify the first line antibiotic treatments for both pneumonia and severe pneumonia, according to the *Paediatrics Association of Nigeria Antibiotics Guidelines for Treatment of Community-acquired Pneumonia*.[21] In Jigawa, doctors (50%) and CHEWs/CHOs (48%) were the mostly likely to get this correct compared to nurses and midwives (29%); whereas in Lagos, doctors (44%), followed by nurses (24%) and CHEW/CHO (12%) were most likely to be correct.

Systems and Structures:

Table 5 summarises the facility audit results and shows that in general facilities in Jigawa were less equipped than those in Lagos though primary facilities were lacking across many areas of equipment and support systems in both states. In Web Appendix 4 we summarise the results below by facility type for each state following the format in Table 5 i.e. we describe typical PPMV/Pharmacy, Primary and Secondary/Tertiary facilities in each of Lagos and Jigawa states separately as case studies.

Of note, intravenous benzylpenicillin, a recommended treatment for severe pneumonia, was only available at one each of the secondary, primary government, and primary private facilities in Jigawa, but also both pharmacies. In general, facilities in Lagos were less well stocked with drugs than those in Jigawa, with only 86% of facilities having amoxicillin and only 21% of facilities having intravenous benzylpenicillin available (Web Table 1).

Measurement of respiratory rate is an entry point to pneumonia diagnosis though only 3 of the 16 facilities in Jigawa (two secondary and one primary facility) had respiratory rate timers (Web Table 2a). In Jigawa, only 4 of 16 facilities had functional pulse oximeters, and only the tertiary facility and two of the secondary facilities had functional oxygen, a resuscitation bag and mask, a glucometer and a nebulizer (Web Table 2a). Notably, in Jigawa, one secondary facility didn't have any of this functional equipment for severe pneumonia cases despite being a referral hospital. In Lagos, 5 of the 11 facilities with data had respiratory rate timers, 7 of 11 had a functional pulse oximeter, and 10 of the 11 facilities had functional oxygen (Web Table 2b).

Healthcare provider FGDs

Clinical presentation

All healthcare providers could describe a 'typical' presentation of pneumonia in their setting, which almost universally included the description of a child with fever, cough and difficulty breathing. Other common signs mentioned were catarrh (mucous), sleeplessness and restlessness, loss of appetite and dehydration. Fever was seen by most to be integral to a pneumonia diagnosis, at all levels of the healthcare system:

"The one I experienced is quite different. The child is 6 years old. What interest me so much is that there was no temperature. The boy was so calm. The only thing I noticed was that the ribs was dipping in and coming out and I was like mother, what is this?" (Respondent 1, Pharmacy, Lagos)

Distinctions between severe and non-severe cases tended to be based on clinical presentation, with common danger signs of convulsions, vomiting and issues with feeding, corresponding well with the IMCI classifications. Low oxygen saturation was mentioned as a sign of severity by two hospital groups in Lagos, although one respondent did not provide the correct value.

Causes of pneumonia

An etiological description of pneumonia was commonly provided when asked to explain what causes pneumonia in children. However, environmental and social causes were also provided. Firstly, environmental factors such as dust and seasonality were given, but also exposure to the cold or activities that might make the child cold. Social causes included poverty, overcrowding, exposure to smoking, and children who were malnourished being more at risk of developing pneumonia. Interestingly, aspiration pneumonia was frequently mentioned by providers in hospital settings from both states as being one of the main root causes for the pneumonia cases that they see.

"Mostly if it is during rainy season, when we have cases of malaria, mostly cerebral malaria so you will find out that those children are unconscious, so they are being fed at home forcefully, so they bring them here with aspiration pneumonias, that is when we have two or three cases"

*(*Respondent 2, Hospital, Jigawa)

Treatment

First line treatment for pneumonia across settings was to give a course of antibiotics, generally stated as broad spectrum antibiotics, alongside paracetamol and multivitamins, and in some cases bronchodilators such as salbutamol. Specific antibiotics which providers mentioned giving included amoxicillin, but, of concern, also included: ceftriaxone, erythromycin, cefuroxime, gentamycin, and cetirizine which is not an antibiotic as the first treatment. In severe cases providers from hospitals mentioned providing oxygen, and suction of mucous to clear the airways. In the absence of oxygen, a secondary provider in Jigawa described resuscitating as an alternative:

"any patients that require oxygen sometimes we do chest compressions, we give mouth to mouth respiration […] just to resuscitate the patients so as to come back to life, thereafter we take referral form and fill" (Respondent 7, Secondary care, Jigawa)

Misperceptions

Several misconceptions about pneumonia emerged from the FGDs, including providers understanding of community misperceptions as well as their own misunderstanding coming across. From the community perspective, the providers considered resistance or hesitation for children to receive oxygen to be linked to the perception that this is a death sentence – although none of the providers felt that this was an insurmountable barrier to oxygen treatment. One of the

pharmacy provider from Lagos also explained his experience in needing to counsel a caregiver that their child was not suffering from witchcraft, but that the child had pneumonia and could be treated using antibiotics – reflecting the challenges of delivering care within pluralistic belief systems.

A concerning misconception amongst PPMV providers in Lagos was their agreement that pneumonia "cannot be transferred", highlighting a fundamental lack of knowledge on the causes of pneumonia. A more common challenge in delivering pneumonia care within formal care settings was the overlap in clinical presentation between malaria, anemia and pneumonia. It appears the default diagnosis amongst healthcare providers is more often anemia, while some reported that caregivers jump to the conclusion that their child has malaria, which they come seeking treatment for.

> *"Sometimes, we under diagnosing pneumonia […] because most patients undergoing fast breathing, what comes our mind is anemia. After sometimes you will correct that, and most of patients have background anemia, the infection is with the red blood cell, so when you correct anemia but still the patients have difficulty in breathing and cough, then you will pay attention towards pneumonia, then we will do chest x-ray and confirm"* (Respondent 5, Secondary care, Lagos).

Approaches to clinical diagnosis

The diagnosis of pneumonia relied mostly on the physical examination of children, and where possible laboratory confirmation using x-ray, full blood count, and confirmation of malaria status. Only three of the groups mentioned that they used pulse oximeters in the diagnosis of pneumonia – stating oxygen saturations of <92%, <90% and <95% would make a child eligible

for oxygen. Those who did not have access to oximeters consistently expressed interest in using them, and most had either seen them used or knew what they were – although not necessarily from a reliable source:

"I don't know the name but I normally see it on TV during all these health films they will put it on the person's finger and I use to think that what is this thing doing on their finger"

(Respondent 5, PPMV, Lagos)

Status of IMCI

Overall there was a lack of consistency around whether IMCI was being implemented by providers or not. While most had heard of IMCI, with the exception of many of the pharmacists, very few participants had said they had been trained. Despite this, almost all could accurately define the purpose of IMCI and the fact that it takes an integrated approach to case management.

When considering the implementation of IMCI, primary facilities in Lagos and Jigawa were more convinced that they currently implement this as their way of managing patients. Secondary and tertiary facilities on the other hand referred to it as something for primary providers who lacked as much clinic training.

"We don't waste time doing all those protocols as provided by IMCI and then unfortunately, most of the patients that we are seeing should have been referred from IMCI service provider so once he comes here there is no need to follow any IMCI protocol any longer" (Respondent 1, Hospital, Jigawa)

However, when asked what guidelines they followed for the management of pneumonia, many providers stated that they relied more heavily on their clinical judgment than guidelines, and in some cases did not consider that they had guidelines to follow.

Enabling environments

When describing what enabled providers to do their jobs effectively, two main concepts emerged – the availability of resources, and the good intentions of themselves and others around them. Resources came in the form of drugs, staff, vaccines and paid salaries, as well as supportive management structures. The good intentions were reflected in both healthcare providers' own personal motivations, which they put forward, as well as philanthropic acts. Providers stated multiple times that they could only do their best with the resources available – however several gave examples of using their own resources to fund transfers or drugs for patients who could not afford it, or even asking to use drugs that other patients had bought to treat care in emergency cases.

"we didn't even consider the woman to go and buy drugs, we borrowed from the patients there, we lay the patient properly on the bed, we start responding, he got PCM injection, then we quickly send for the doctor on call, so I set an IV line, I borrowed PCM injection from another patient" (Respondent 4, secondary care, Jigawa)

In one setting in Lagos, the hospital also received donations in order to help patients pay their bills. On the other side of this however was criticism leveled at staff at facilities selling drugs, which are provided free from the government, and the lack of local donations compared to those from international funders.

Discussion

We conducted a mixed-methods evaluation of the current capacity to deliver quality IMCI care for paediatric pneumonia in two states in Nigeria. We found considerable gaps in both healthcare providers' knowledge of pneumonia and the infrastructure needed to provide effective treatment. Among these were, gaps in IMCI knowledge which was generally low across both states with especially low knowledge relating to how to recognize a child who is anaemic, what to counsel mothers/caregivers on, and the main symptoms to check in sick children. The gaps in infrastructure needed for effective management of childhood pneumonia that we identified include limitations in the availability oxygen apparatus, pulse oximeters, respiratory rate timers, antibiotics, as well as 24-hour power and water availability.

The World Health Organization (WHO) and United Nations International Children's Emergency Fund (UNICEF) established Integrated Management of Childhood Illness (IMCI) with the aim of reducing under-five mortality, morbidity and disability and improving child growth and development.[22] IMCI is an important strategy used in achieving child health related Millennium Development Goals when sufficiently well implemented.[22] In Nigeria, IMCI training, mentoring and supportive supervision needs to be more widely implemented to improve current health provider knowledge on pneumonia, and general IMCI guidelines, which was found to be poor across all groups of providers and all facility types we surveyed. Our study indicates the proportion of health providers trained in IMCI across the two states is far below the WHO recommendation of 60%.[8] Nationally <25% of facilities in Nigeria were estimated to have at least 60% of health workers trained in IMCI in 2016. [23] Though IMCI is a federal policy and it has been incorporated into the national child health strategy it is beset by a lack of coordination

and government funding. [23] IMCI is therefore not followed in many facilities, and our qualitative data suggests primary facilities may use it more than secondary and tertiary facilities.

Doctors had slightly higher IMCI knowledge score than nurses and midwives and community health workers. This may be expected given doctors undergo more training compared to their counterparts, though interestingly our qualitative results suggest some doctors think IMCI should mainly be used by nurses and community health workers. Training all cadres of health worker should allow effective understanding of IMCI among all of them, as found in the multi-country evaluation of IMCI considering improved case management of childhood illness across countries with different mixes of cadres, e.g. Tanzania,[24] and Brazil.[25]

IMCI could be properly implemented in Nigeria if certain conditions are met. Support from health institutions including improved planning, coordination and teamwork, regular training, supervision and mentoring of health personnel, and support for and from communities, could enhance IMCI implementation.[22,26]

The need for on-going supervision and monitoring as a means to sustaining effective training was highlighted in our study. Though there were gaps in training that need to be bridged, effective supportive supervision will also help health providers understand how to implement IMCI and other guidance, oversee their progress, and be held to account, which in turn would enable proper functioning of work units. Previous studies have found a dearth of supervision to be an added challenge in the implementation of IMCI.[8,27,28]

In general, availability of essential equipment was found to be poor across facilities; notable gaps as identified by our study were lack of thermometers and respiratory rate timers, which are the most basic equipment needed to implement routine case management. A similar pattern of results

was reported in the IMCI multi-country evaluation conducted in 2002, which indicated that many countries lack adequate health system support for IMCI implementation including insufficient availability of drugs, equipment, and referral facilities as well as poor adherence to IMCI guidelines, high turnover among trained staff and inadequate supervision.[29]

We observed a gap in the availability of functional oxygen apparatus and pulse oximeters across the two states. Oxygen equipment was more available in Lagos but without always being supplemented with pulse oximetry diagnosis, which is needed for effective decision-making. This concurs with a study conducted by McCollum and colleagues in 2013[30] which shows that pulse oximetry utilization was limited to operating theatres despite its importance in identifying hypoxemia in all paediatric patients. Recent research in Nigeria has also demonstrated that delivery of oxygen therapy was limited by electricity supplies, oxygen concentrator/cylinder availability, and inadequate use of pulse oximetry.[31] Administration of oxygen to children without oximetry could be detrimental[32], therefore we strongly advocate that both should be adequately provided in all facility types.

Whilst primary facilities are expected to have IV antibiotics recommended for severe pneumonia such as benzylpenicillin as per national guidelines,[33] pharmacies are not. Although we found both pharmacies we surveyed in Jigawa to stock benzylpenicillin and gentamycin (Web Table 1). Similarly oxygen and pulse oximetry is not expected at pharmacy level though pulse oximetry is expected at primary care level[11] and oxygen is recognized in national guidelines as being important at primary care level too.[34]

Based on the audit data, we observed slightly different patterns in patient load. This may have to do with caregivers self-selecting where they attend differently in different states – for example if

mainly non-severe cases present to primary care in Lagos, referrals would be minimal, while in Jigawa, if caregivers generally do not go to primary care and instead wait until their child is very sick then go to the secondary care centre, this would result in fewer referrals. This pattern is somewhat supported by our focus group discussions: in primary care in Jigawa few providers felt able to treat pneumonia and reported that caregivers present their children in late stages of illness.

Caregivers in Lagos should be encouraged to present cases without danger signs at primary health level, and healthcare providers can refer to secondary or tertiary care if needed. This would help reduce workload in both secondary and tertiary facilities. Meanwhile, Jigawa state primary healthcare providers should be equipped with the skills necessary to identify and manage pneumonia cases, and caregivers should be counseled on the importance of early presentation of illnesses.

Limitations

Given only 3.8% of all under-5 cases in Jigawa and 4.8% in Lagos were indicated to be acute respiratory infection (ARI) (Table 4), it is likely that ARI and pneumonia cases are misclassified or missed – which is supported by our qualitative data. This also highlights an area where training, mentoring and supervision of health workers could lead to improvements. It also means the admission, referral and case fatality estimates in Table 4 may be inaccurate. This is also possible because these caseload estimates were obtained from interviews with facility leads as part of our facility audit rather than medical record review or direct observations.

Our study only focuses on one LGA within each of Lagos and Jigawa states and only samples a cross-section of facilities within each LGA and the health workers available at the facility during

the data collection visit. The extent to which our results can be generalized to other areas of Nigeria is therefore limited. Our case study data nevertheless highlights important issues in the identification and management of childhood pneumonia that need to be addressed.

Conclusion

Effective management and treatment of paediatric pneumonia is affected by the quality of IMCI implementation, institutional support, availability of equipment and supplies, early presentations and paucity of providers' knowledge. Interventions need to be targeted towards these identified gaps.

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