Breath Counter : A New Device for Household Diagnosis of Childhood Pneumonia

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Illiterate Traditional Birth Attendants (TBAs) were trained to diagnose pneumonia in children using their visual judgement of tachypnoea. This method resulted in 41% wrong diagnosis in the cases with borderline respiratory rate. A simple device, named 'Breath Counter' was designed and TBAs were trained to diagnose pneumonia in children using this instrument. The agreement of TBAs' diagnosis, with diagnosis using WHO criteria of respiratory rate improved from unaided 60% (30/50) to 82% (41/50) by the use of Breath Counter (p<0.05). Breath Counter is simple, cheap, effective and can be used even by illiterate persons to diagnose pneumonia in children. It has the potential of becoming a household diagnostic aid.

Key words : *Childhood pneumonia; Breath counter; Traditional birth attendants (TBA); Household diagnosis.*

Pneumonia accounts for more than 25% of childhood deaths in developing countries causing 4 million deaths each year.[1] Case management of pneumonia by trained health workers has been suggested by the World Health Organisation (WHO) as a strategy to control this mortality.[2] We have earlier reported a field trial in Gadchiroli, India in which the pneumonia mortality rate in children in 58 villages was reduced by 54% by providing community based management of pneumonia.[3] In this trial, paramedic workers and village health workers were trained to diagnose pneumonia in children by counting respiratory rate (RR) with the help of wrist watch. Using WHO criteria, pneumonia was diagnosed if RR exceeded 50 per minute in a child with cough. WHO has subsequently suggested use of 60, 50 and 40 breaths per minute as cut off points to diagnose pneumonia in infants up to 2 months, 2 to 11 months and toddlers of 1 to 4 years respectively.[4]

To improve outreach of case management service, we trained Traditional Birth Attendants (TBAs) to diagnose and treat childhood pneumonia.[3] This was the first published report of the involvement of TBA's in the management of pneumonia. Since almost all of them were illiterate, they could not use watches. They also could

not usually count more than 12 (a dozen) at a time. Hence they were trained to diagnose pneumonia by using their visual judgement whether the child looked tachypnoeic (local term 'Lahak' or 'Dhapa'). Their visual sense was cultivated by showing them children with pneumonia and a video film on childhood pneumonia. The present study was undertaken (a) to ascertain diagnostic accuracy of TBAs by comparing their visual judgement of pneumonia with the WHO criteria of RR and (b) to develop and test a simple diagnostic aid to improve accuracy of diagnosis of pneumonia by illiterate persons.

MATERIAL AND METHODS

Forty six TBAs who had been earlier trained to diagnose childhood pneumonia using their visual judgement had assembled for monthly review meeting. They were successively shown 5 children (A,B,C,D,E) who were deliberately selected to represent wide range of RR and age. TBAs were asked to judge each child if it was normal or had pneumonia. A physician (ATB) counted RR of these children at the same time and classified them as with or without pneumonia using age specific criteria of RR suggested by WHO.[4] Diagnostic accuracy of TBAs' judgement was estimated as proportion in agreement with diagnosis by WHO criteria.

A simple device was designed in which a sort of abacus and an one minute sand-timer were combined in a wooden frame. The abacus had three rows of beads for three different age groups of children. The first row was to be used for infants up to 2 months of age. It had five green and a sixth red bead. Using one minute sand-timer, the user was to count breaths and move one

bead for each completed ten breaths. If, within one minute, the red bead had to be moved, it denoted that the child had RR 60 or more per minute signalling presence of pneumonia. Thus illiterate TBAs could diagnose pneumonia without being required to count more than 10 at a time. Second row, to be used for infants of 2 to 11 months age, had four green and fifth red bead denoting pneumonia at RR 50 or more. Third row for 1 to 4 years children had three green and fourth red bead to signal pneumonia if RR exceeded 40.

This device posed two problems. Three rows of beads were confusing for TBAs. It had very narrow, ½ inch wide base, which easily titled often resulting in stoppage of flow of sand in the sand-timer. Hence a second version was designed which was larger (11" × 4.5" × 2.5"), which had wider base (2.5") and which had only two rows corresponding with 60 and 50 RR with pictures of new born and grown up infant pasted against the respective rows. The designs were prepared by the physician (ATB) and a local carpenter manufactured 10 pieces of the instrument.

TBAs were invited to use this device. Ten TBAs who first volunteered were selected for training which included three sessions of about one hour each. At the end of the training, diagnostic accuracy of these ten TBAs was tested initially without and then with the use of "Breath Counter" on same 5 children. (F,G,H,I,J). These children were selected for their borderline RR (arbitrarily defined as within 10 breaths of the WHO cut off points for the age) since TBA's had difficulty in correctly diagnosing penumonia in such borderline cases. TBAs' had difficulty in accurately diagnosing pneumonia in such borderline cases. TBAs' diagnoses were compared

with physician counting breaths at the same time and categorising same children in to with or without pneumonia using 60 and 50 breaths as cut off points depending upon the age of the child. The p value was calculated using chi square test of significance.

RESULTS

The diagnostic accuracy of visual judgement of TBAs expressed as agreement with age specific RR criteria of WHO is presented in Table 1. One TBA who was deaf and could not understand instructions properly was

TABLE 1. Agreement Between TBAs'* Visual Judgement of Pneumonia and Diagnosis by Counting Respiratory Rate (RR)

Child	Age	RR/minute	No.	%	Mean
Extremes of RR					
Child A	2 mo	76	40/46	86.9%	
					91.3%
Child B	2.5 yr	26	44/46	95.7%	
Borderline RR					
Child C	6 mo	55	28/45	62.2%	
Child D	8 mo	43	26/45	57.8%	58.6%
Child E	20 days	63	25/45	55.6%	

*TBA = Traditional Birth Attendant

TABLE 2. Diagnosis of Pneumonia by TBAs* Without and With Aid of Breath Counter in Children with Borderline Respiratory Rate (RR)

Child,	Age	RR/minute	Without Breath Counter No.	With Breath Counter No.	P
Child F	4 mo	59	6/10	8/10	
Child G	11 mo	54	6/10	9/10	
Child H	7 mo	44	7/10	8/10	
Child I	16 days	52	5/10	9/10	
Child J	1 mo	65	6/10	7/10	
		Total	30/50 60%	41/50 82%	<0.05

*TBA = Traditional Birth Attendant.

** Correct diagnosis was defined as agreement with the diagnosis by age specific respiratory rate suggested by WHO[4]

omitted from the group after first two children. There was 91.3% agreement in children with extreme RR. But the agreement dropped to 58.6% in children with borderline RR demonstrating imprecision in TBAs' diagnosis at such RR.

Comparison of diagnostic accuracy of 10 TBAs without and with "Breath Counter" in 5 children with borderline RR is presented in Table 2. Of the 50 measurements with "Breath Counter", 41 resulted in correct diagnosis, 4 in wrong diagnosis and 5 could not be completed due to problems in using the "Breath Counter". The difference in diagnostic accuracy with and without "Breath Counter" was statistically significant (p < .05)

DISCUSSION

TBAs' unaided visual judgement agreed with diagnosis of childhood pneumonia by WHO criteria in 91% cases at the extremes of RR but only in 58.6% when RR was borderline thus necessitating improvement in diagnosis of such borderline cases. Proportion of correct diagnosis in borderline cases improved from 60% to 82% with the aid of "Breath Counter". This new device can become an useful diagnostic aid enabling even illiterates in the diagnosis of childhood pneumonia.

In this study TBAs' judgement was compared with diagnosis by RR using WHO criteria and not with medical or radiological diagnosis of pneumonia. Since this WHO yardstick based on RR itself is not 100% perfect,[5,6] the actual precision of TBAs' diagnosis may be less than reported here. A possibility, however, can not be ruled out that in some of the events of disagreement between TBAs' unaided judgement and diagnosis based on RR,

TBAs might be correct. Two earlier clinical studies have reported good agreement between mother's judgement that child was seriously ill and physician's medical diagnosis of pneumonia.[5,6] This issue can be resolved in future by comparing TBAs' judgement with medical diagnosis. But in this study we decided to compare TBAs' judgement with diagnosis by RR, because counting RR was the diagnostic method employed in the programme to control acute respiratory infections in children in 47 countries. *The purpose of "Breath Counter" was to bring TBAs' diagnosis close to one based on RR.* The comparison of correct diagnosis with and without "Breath Counter" was restricted to borderline cases because these had the highest potential of misclassification. There was statistically significant improvement in the correct diagnosis of such cases.

"Breath Counter" developed by us is simple. It combines two traditional methods of measuring time and counting. Moreover it overcomes the inability of TBAs to count more than 12. It helps TBAs arrive at a definite decision that the child has pneumonia when the red bead is moved. The decision is age specific. The breath counter costed Rs. 60 a piece since only 10 pieces were produced. It will be cheaper when mass produced.

The problems encountered were with the timer part of the device. Inspite of using better sand timers from those available in the market, time required to completely pass the sand varied from 57 to 62 seconds. Occasionally the flow of sand stopped necessitating restart of counting. TBAs found it difficult to simultaneously pay attention to breathing movements of the child, abacus and the flow of sand. Thus out of 50 measurements, in 5 instances count

could not be completed due to the problems of the instruments. Many of these difficulties can be overcome by replacing the sandtimer with an electronic timer which gives alarm sound at completion of one minute. UNICEF and WHO have very recently developed such electronic timer which is under trial.[8] Though this was not available to us, utilising it in our "Breath Counter" will further improve the device and diagnostic accuracy.

TBAs also had difficulty in selecting correct row of beads according to the age of the child. Hence we have reduced number of rows from three to two and put small picture labels of children of appropriate age to guide in the selection of correct row of beads. Since the third row corresponding to 40 breaths has been removed, cut off of 50 breaths has to be used for 1-4 years children as well. This was permissible for TBAs because they less commonly managed sick toddlers. If used on all underfive children, the lack of third row corresponding to 40 breaths may lead to some underdiagnosis in 1-4 years children.

The device was tested on 10 TBAs who volunteered to be trained introducing an element of self selection. All TBAs may not show equal interest in learning a new device, especially if they were already used to diagnose pneumonia using their visual judgement alone.

Children below five years age get, on an average, 6 attacks of respiratory infections per year[3], majority of which are upper respiratory infections requiring no antibiotic. Active case detection of pneumonia by periodic home visiting by health workers is an inefficient method to identify children who need antibiotic.[7] Instead, health education of parents to suspect pneumonia in their child and to seek care has been shown by us to improve coverage and impact.[3] Ability of parents and health workers to differentiate upper respiratory infection from pneumonia is the most crucial skill in case management approach to control deaths due to pneumonia. Parents as well as TBAs who cannot count up to 50 or 60 or who do not have watches need some other aid to enable them to suspect or diagnose pneumonia in children. "Breath Counter" can effectively perform this role.

"Breath Counter" can perform an additional educational role. Respiratory rate should become widely known as an important sign to be watched in child with cough; similar to temperature in a child with fever or signs of dehydration in a child with diarrhea. Use of "Breath Counter" emphasises and teaches this. Hence we suggest that "Breath Counter" can become a household diagnostic aid and contribute significantly in reducing childhood mortality due to pneumonia.

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