

Caregivers' Knowledge, Practices about Childhood Diarrhea and Pneumonia and their Perceptions of Lady Health Worker Program; Findings from NIGRAAN Implementation Research Project

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Abstract

Background: Despite 60% coverage by Lady Health Worker (LHW) Program, 30% of child deaths in Pakistan are still due to diarrhea and pneumonia. Caregivers are an important stakeholder yet there is little information on their case management practices and utilization of LHW Program. This study explored caregivers' knowledge and practices about childhood diarrhea and pneumonia and utility of LHW services before and after a supportive supervision intervention.

Methods: Cross sectional surveys were conducted with caregivers' (mothers) pre and post intervention in project NIGRAAN. The intervention aimed to improve LHSs clinical and supervisory skills of lady health supervisors in order to improve LHW performance and ultimately impact caregiver practices. 4250 households were surveyed. Questionnaire was adapted from PDHS 2012-13. Differences between intervention and control groups were assessed using chi square test. P-value of <0.05 was considered significant.

Results: Comparing baseline to end line, there were significant overall improvements in caregivers' knowledge of loose motion (62 to 84%) and dehydration (12 to 18%) as signs and symptoms of childhood diarrhea. There was also a significant overall increase in caregivers' knowledge of presenting features of pneumonia- i.e. fever (58 to 86%), cough (51 to 61%) and breathing problems (25 to 57%). The proportion of caregivers seeking advice for diarrhea from public sector significantly improved in intervention arm from 20% to 29%. Private sector however remained overall preferred choice for care seeking. There was significant overall improvement in awareness about LHWs functioning (93 to 99%) and household visits (91 to 98%). Actual care seeking from LHWs however stayed low ($\leq 0.3\%$)

Conclusion: In order to improve utility and expand coverage of LHW Program interventions aimed at providing supportive supervision have the potential to improve caregiver practices and utilization of available services and decrease childhood deaths due to preventable illnesses.

Keywords: Knowledge; Practice; Perception; Diarrhea; Pneumonia; Community case management; Children under five; Caregiver; Lady health worker program; Survey

Background

Pneumonia and diarrhea remain the leading childhood killers, together responsible for 29% of all under-five mortality which translates to loss of more than 2 million young lives annually [1]. These deaths occur disproportionately more among the poorest and most disadvantaged children with nearly 90% of deaths occurring in South Asia and sub-Saharan Africa. Pakistan showed a slow progress and under achieved its millennium development goal (MDG-4) targets as the under-five mortality fell from 117 deaths in 1990 to 86 deaths per 1,000 live births in 2013 with a gain of only 31 points, lagging behind some of the better performing neighbors like Sri Lanka, Nepal and India [2]. Much of this mortality can be prevented with proven lifesaving interventions for which the global coverage continues to remain low. The Global Action Plan for the Prevention and Control of

Pneumonia and Diarrhea (GAPPD) by 2025 identifies that for reducing morbidity and mortality, the appropriate case management of children ill from pneumonia and diarrhea should include improved care seeking and referral, appropriate case management at the health facility and community level, availability of supplies like Oral Rehydration Solution (ORS), zinc, antibiotics and continued feeding during illness [1].

In Pakistan, the community case management practices of caregivers for diarrhea and pneumonia need improvement. Timely recognition of symptoms of diarrhea and pneumonia is of utmost importance by community caregiver as delay in seeking care could be life threatening, especially for pneumonia [3,4]. The recognition of pneumonia by caregivers is generally poor [5]. A recent study in Mirpurkhas Pakistan found that not all caregivers were able to recognize the basic symptoms of pneumonia. Amongst those probed, 40% did not report fast breathing and chest indrawing as symptoms of pneumonia [6]. Pakistan Demographic Health Survey (PDHS) of 2012-13 reports that only 42% of acute respiratory infections (ARI)

cases received antibiotics. Of those with diarrhea, 62% did not get ORS and 39% were not taken to a health care provider [7]. Similar results were reported from low income peri urban communities of Karachi with only 41% ORS usage [8]. Moreover, a hospital based study showed that for signs of dehydration, 40% mothers gave nonspecific responses and only 26% responded with sunken eye as the only sign of dehydration [9]. These trends of low recognition of danger signs and care seeking are aligned with studies from other developing countries like Sri Lanka, India, Zambia and Uganda to name a few [10].

The low utilization of public sector health services occurs across all developing countries. A study from India reported that 35% of caregivers consulted private practitioners and 16% went directly to a pharmacy [11]. A recent multicounty analysis of care seeking patterns of parents for their sick children showed that in South Asian countries including Pakistan care seeking was predominantly from the private sector, and community health workers were not an important source of care [12]. An analysis of demographic health survey and multiple indicators cluster survey datasets showed that among countries with high mortality due to childhood acute respiratory illnesses, Pakistan has the lowest (10%) public sector care utilization [13]. Similarly, a study conducted in Karachi on health seeking behaviors of mothers for childhood illnesses showed that only 11.7% sought care from government doctors [14].

The Government of Pakistan's national program for Family Planning and Primary Health Care relies on Lady Health Workers (LHWs) chosen from their community as change agents for bringing health services at doorsteps. Currently this program covers more than half of the country's population including 60-70% of the rural population [15]. Besides other maternal and child health services, the LHW through her limited supply of medicines is able to treat simple illnesses like diarrhea and minor cases of ARI in children under-five. Despite showing significant improvements in child health services like treatment of childhood diseases, vaccination coverage and promoting breastfeeding [16], the LHWs knowledge and practices for community case management (CCM) have failed to translate to the caregiver level as evident by low recognition and poor case management practices by caregivers for both diarrhea [7-9] and pneumonia [5-7].

This study explores if there was any improvement brought in caregivers' (mothers') knowledge and practices about childhood diarrhea and pneumonia as well as their perceptions and utility of the Lady Health Worker Program (LHW-P) before and after a supportive supervision intervention.

Methods

The project and intervention

With regards to the causes and determinants of stagnant under five mortality rate, the 'Fourth External Evaluation of National Program for Family Planning and Primary Health Care' identified that not only the LHWs lack skills for managing cases of pneumonia and diarrhea in the community but their lady health supervisors (LHSs) also have inadequate supervisory and clinical mentorship skills [17]. To address these shortcomings, NIGRAAN (an Urdu word meaning supervisor) was designed as a randomized controlled trial (RCT) to study the impact of enhancing structured supportive supervision by LHS on LHW's performance. It was hypothesized that ultimately this would translate to improved community caregivers' knowledge and practices of diarrhea and pneumonia. The intervention consisted of training to

build LHSs knowledge and skills, clinical mentorship and written feedback to LHWs. For the purpose of NIGRAAN, all the 34 functional LHSs and five LHWs working under each LHS (total 170 LHWs) constituted the study sample. Each LHS served as a cluster. 17 LHSs were randomly allocated to intervention and 17 to control arm [18]. This paper describes the trickle down impact of NIGRAAN's intervention at caregiver level through more structured interactions among LHWs and LHSs.

Study design and setting

Cross sectional household surveys were conducted at baseline (pre intervention in 2014) and then at end line (post intervention in 2015) after an interval of 26 months in District Badin, Sindh.

Sampling technique and sample size

Multistage sampling technique was used to select households with children under-five. The sample size was based on the expected number of children under five who experienced an episode of pneumonia per year. The estimated incidence of pneumonia among children under 5 in Pakistan is 0.41 episodes per child-year (*e/cy*). In order to achieve 80% power for estimating the effect of the intervention at 95% confidence interval and intra-cluster correlation coefficient of 0.122, it was estimated that in the first stage at least 8,500 households needed to be selected in each arm (one LHW covers approximately 100 households). Second stage of sampling consisted of systematic randomization; taking every fourth household with an expected number of one child under 5 years per household. The final sample to be achieved was thus 2,125 households in each arm [18].

Data collection

The data collection instrument was adapted from PDHS 2012/13. The questionnaire included sections on background characteristics of caregivers, childhood diarrhea and pneumonia as well as the awareness and care giver perceptions of the lady health worker program. The questionnaire was translated into local language (Sindhi), back translated into English to check for consistency in language and then re-translated into Sindhi. The tool was pretested in district Badin prior to survey. The interviews were carried out by trained field workers who were supervised.

Data analysis

The outcome of interest variables pertaining to unprompted care giver knowledge of diarrhea and pneumonia symptoms, practices for care seeking and complimentary feeding as well as awareness, perceptions and utilization of LHW program are reported. The frequencies and proportions are reported for basic demographic and the outcome of interest variables. To assess the pre and post intervention change in knowledge, skills and other parameters between the two study arms chi square test was used. A two-sided P-value <0.05 was considered to be significant for all tests. The data was analyzed using STATA/MP version 13.1.

Ethical approval

The ethical approval was obtained as part of larger RCT from Aga Khan University (AKU) and World Health Organization (WHO). Informed consent was taken from all the child care takers prior to data collection.

Results

Characteristics of respondents

The caregivers who responded to the survey at baseline and end line were quite similar in terms of their socio-demographic characteristics. These include caregivers' age, gender, marital status, education and region. Almost all (98%) caregivers were married females with more than half being 26-35 years of age. Majority (70-75%) had no formal education and belonged to rural areas of District Badin.

Caregivers' knowledge and practices regarding diarrhea

While assessing any change for caregivers' knowledge of diarrhea signs and symptoms, there were significant improvements. Loose motions as a symptom of diarrhea was reported in both intervention and control arms (Table 1). Likewise, the proportion of caregivers mentioning any of the signs of dehydration also significantly increased from baseline to end line (Table 1).

Outcome indicator	Intervention			Control			Overall		
	Baseline	End line	Baseline vs. End line	Baseline	End line	Baseline vs. End line	Baseline	End line	Baseline vs. End line
	Percentage	Percentage	P value	Percentage	Percentage	P value	Percentage	Percentage	P value
Percentage caregivers with knowledge of loose motion as a key symptom of diarrhea	67	85	<0.001	57	83	<0.001	62	84	<0.001
Percentage caregivers with knowledge of any of the signs of dehydration for diarrhea	12	18	0.001	12	17	0.001	12	18	<0.001
Percentage caregivers increasing frequency of drinking during diarrhea illness episode	34	23	<0.001	33	24	<0.001	33	23	<0.001
Percentage caregivers increasing frequency of eating during a diarrhea illness episode	4	3	0.22	3	5	0.05	4	4	0.61
Percentage caregivers seeking advice for treatment from any source during a diarrhea illness episode	85	87	0.63	88	87	0.07	87	87	0.39
Percentage caregivers seeking advice from public sector (as compared to private) for a diarrhea illness episode	20	29	<0.001	27	29	0.08	23	29	<0.001
Percentage caregivers using store-bought ORS packets during a diarrhea illness episode	70	72	0.72	73	70	0.11	72	71	0.39
Percentage caregivers using home-made ORS during a diarrhea illness episode	53	51	0.52	58	45	<0.001	55	48	<0.001

Note: The bold highlights the significant changes from baseline to end line; For percentage, all digits after decimal place have been rounded off

Table 1: Knowledge and practices of caregivers' regarding diarrhea in children under five.

When probed for their health seeking behavior, most preferred private health practitioners. The proportion of caregivers seeking advice from public sector showed improvements in both arms, though significant only in intervention (Table 1). At baseline, only 34% of caregivers in intervention and 33 % in control arm resorted to increasing intake of water during a diarrhea episode. However at end line this practice showed further decline (Table 1). Similarly the proportion of caregivers who increased feeding during illness was very low at baseline (intervention: 4% and control: 3%) and failed to improve by end line.

Caregivers' knowledge and practices regarding ARI

Breathing problem was cited as a key symptom of pneumonia by 25% of caregivers at baseline which increased to 57% by the end line survey. The proportion of caregivers with knowledge of fever and cough as presenting features of pneumonia also significantly increased from baseline to end line (Table 2).

Outcome indicator	Intervention			Control			Overall		
	Baseline	End line	Baseline vs. End line	Baseline	End line	Baseline vs. End line	Baseline	End line	Baseline vs. End line
	Percentage	Percentage	P value	Percentage	Percentage	P value	Percentage	Percentage	P value
Percentage caregivers with knowledge of fever as a key sign of pneumonia	63	87	<0.001	54	85	<0.001	58	86	<0.001
Percentage caregivers with knowledge of cough as a key symptom of pneumonia	55	63	0.011	47	59	0.001	51	61	<0.001
Percentage caregivers with knowledge of breathing problem/difficulty breathing as a key sign of pneumonia	25	62	<0.001	24	50	<0.001	25	57	<0.001
Percentage caregivers increasing frequency of drinking during an ARI illness episode	23	8	<0.001	23	8	<0.001	23	8	<0.001
Percentage caregivers increasing frequency of eating during an ARI illness episode	3	2	0.52	3	1	0.198	3	2	0.17
Percentage caregivers seeking advice for treatment for an ARI illness episode	85	96	<0.001	88	96	0.030	87	96	<0.001
Percentage caregivers seeking advice from public sector (as compared to private) for an ARI illness episode	19	18	0.42	25	19	0.023	22	18	0.02
Percentage caregivers using any medicine taken by child during an ARI illness episode	91	98	0.005	92	96	0.05	92	97	0.001

Note: The bold highlights the significant changes from baseline to end line; For Percentage, all digits after decimal place have been rounded off

Table 2: Knowledge and practices of caregivers' regarding ARI in children under five.

The private sector was the preferred choice of treatment while seeking care for pneumonia. Use of public sector stayed static in intervention arm while showed significant decline in control arm (Table 2). Similar to diarrhea, the practice of increasing water intake during an illness episode was low at baseline (23%) and showed a significant decline by end line to around 8%. Correspondingly, the practice of increasing feeding during ARI was actually followed by very few caregivers (3%) at baseline and failed to improve by end line.

enough of managing diarrhea and pneumonia in their children under five (Table 3). From baseline to end line, there were significant improvements in awareness about LHWs functioning in the area and their visits to households across both intervention and control areas. However, the perceived LHW capability to provide diarrhea and pneumonia care failed to show any significant differences in both arms (Table 3). The actual care seeking from LHWs was low ($\leq 0.3\%$) for diarrhea and ARI across both baseline and end line surveys (Table 4).

Caregivers' knowledge, practices and perceptions of LHW program

At baseline, a vast majority of caregivers were well aware of LHW functioning in their areas but very few considered them capable

Outcome indicator	Intervention			Control			Overall		
	Baseline	End line	Baseline vs. End line	Baseline	End line	Baseline vs. End line	Baseline	End line	Baseline vs. End line

	Percentage	Percentage	P value	Percentage	Percentage	P value	Percentage	Percentage	P value
Percentage caregivers with awareness of LHW functioning in their area	93	98	<0.001	93	99	<0.001	93	99	<0.001
Percentage caregivers stating that LHW ever visited household	91	97	<0.001	91	98	<0.001	91	98	<0.001
Percentage caregivers which considered LHW capable enough for diarrhea and ARI care for children under fives	16	18	0.61	21	23	0.72	18	21	0.57

Note: The bold highlights the significant changes from baseline to end line; For percentage, all digits after decimal place have been rounded off

Table 3: Knowledge, practices and perceptions of caregivers' regarding LHW program.

Caregivers' seeking care from LHWs	Intervention		Control	
	Baseline	End line	Baseline	End line
	Percentage	Percentage	Percentage	Percentage
Diarrhea	0.3	0.15	0.3	0.3
ARI	0	0	0.3	0

Note: Numbers too small to apply statistical test

Table 4: Utilization of LHWs for providing care to children under five.

Discussion

The study found that comparing baseline to end line survey there were some improvements in the knowledge of caregivers about childhood diarrhea and pneumonia as well as their perceptions about the lady health worker's program. A study by Ciccone et al. Project Leonardo demonstrated that care managers were able to bring about effective improvements in patients' health knowledge, self-management skills and behaviors [19]. However, it is important to consider that the latter study was in a facility setting.

The expected LHW to caregiver interactions focused on diarrhea and pneumonia however did not occur. This is evident by the low utilization rates of LHWs, possibly contributing to lack of expected improvement in CCM practices at the caregiver level. Our results are contrary to a recent review in developing countries which cited around 5% median utility of community health workers for diarrhea and 4% for pneumonia [5]. Moreover, a recent systematic review reported not only improvements in care seeking brought about by community based interventions but also found evidence that the CCM of these illnesses was associated with reduction in associated mortality [20].

Our study results show that despite the high awareness of LHW program and frequent LHW visits, the caregivers lack confidence in community health workers for management of diarrhea and pneumonia in children under five resulting in their low utility as frontline health workers. Several underlying contextual factors need to be taken into account which divert the attention of LHWs from their routine responsibilities. Most notably the focus of program managers and district health officers is also on other activities like supplementary immunization campaigns and family planning. In addition, the ability of LHWs to provide care for childhood illnesses is hampered by several structural issues that have plagued the LHW program in recent years

like lack of supplies, transport, poor district health referral system and delayed disbursement of remuneration to name a few [21]. The community caregivers are either unaware of LHW's role in management of diarrhea and pneumonia or bypass them to seek care from other sources, mostly private sector.

While the role of continued drinking and eating during a childhood illness episode is well established, our results show that very few caregivers actually follow this practice. There was a decline in both drinking and eating frequencies between baseline and end line assessments during our intervention that was not anticipated. An RCT from Lahore Pakistan showed that training of community health workers in counseling for complimentary food positively influenced maternal behaviors and practices for supplementary feeding [22]. The LHWs need to counsel mothers to promote complimentary feeding and drinking during an illness episode.

The observation that most of the improvements in caregivers' knowledge in the intervention areas were also transferred to the control areas indicates that in real life, it is difficult to avoid cross over if the intervention and control areas fall within the same geographic locality [23]. In addition, unlike clinical research, the control arm might be affected by other contextual factors. The mere presence of NIGRAAN's supportive supervision intervention with continuous monitoring of LHWs in both arms might have improved the performance in the control group. Moreover, factors intrinsic to the LHW program like the recent regularization of LHWs (before the end line survey) as government employees could have improved their performance.

A study conducted at Haripur Pakistan showed that the care seeking from LHWs for suspected pneumonia increased from 0.7% to 49% following a community mobilization intervention to increase demand

from community and availability of medications to the LHWs [24]. Similarly, a study from Matiari district of Pakistan showed that the provision of reimbursement for travelling costs and medications to LHWs resulted in successful diagnosis and treatment of severe cases of pneumonia [25]. Our study failed to show similar changes as a result of low demand from community and lack of essential logistic prerequisites for service provision by LHWs. Trainings focused on childhood illnesses, transportation, medicines and other logistics were some of the contextual barriers hampering LHW performance. Unless these contextual factors are addressed, the utility of this vital community health work force will fail to improve.

The program managers need to seriously consider prioritizing the already mandated role of LHWs in community case management of childhood diarrhea and pneumonia by providing them the enabling environment to contribute to reduction of associated morbidity and mortality.

A general limitation of surveys administered through a questionnaire introduction of measurement or response bias due to errors in the questionnaire design and the data collection process [26]. The way questions in a questionnaire are phrased, translated into local language, asked by data collectors and understood by respondents during administration can also influence results. Therefore, we adapted the questionnaire from a standardized and validated national survey (PDHS) making minor modifications to make it context specific. The whole process of data collection and subsequent analysis was guided by a trained biostatistician who was part of the research team.

Conclusion

This study tried to test whether interactions that were aimed to enhance supervision by LHSs to LHWs could improve caregivers' knowledge and management practices for childhood diarrhea and pneumonia. There were significant improvements in caregivers' knowledge of signs and symptoms of childhood diarrhea and pneumonia in both intervention and control groups. However, specifically in the intervention group, the proportion of caregivers seeking advice for diarrhea from public sector significantly improved. We conclude that the intervention such as training on childhood illnesses, transportation and provision of supplies and medicines can improve LHW performance and contribute to their better utility. A more robust intervention aimed at improving the performance of LHWs and their credibility in the communities they serve is needed. The knowledge gained from this study can serve as a reference for communities with similar situations.

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Trial Registry

NIGRAAN is registered with the 'Australian New Zealand Clinical Trials Registry'. Registration Number: ACTRN1261300126170

References

1. World Health Organization (2013) Ending preventable child deaths from pneumonia and diarrhoea by 2025: the integrated global action plan for pneumonia and diarrhoea (GAPPD).
2. UNICEF/WHO/The World Bank/UN Pop Div (2014) Levels and trends in child mortality report.
3. Källander K, Hildenwall H, Waiswa P, Galiwango E, Peterson S, et al. (2008) Delayed care seeking for fatal pneumonia in children aged under five years in Uganda: a case-series study. *Bull World Health Organ* 86: 332-338.
4. Onyango D, Kikui G, Amukoye E, Omolo J (2012) Risk factors of severe pneumonia among children aged 2-59 months in western Kenya: a case control study. *Pan Afr Med J* 13: 45.
5. Geldsetzer P, Williams TC, Kirolos A, Mitchell S, Ratcliffe LA, et al. (2014) The recognition of and care seeking behaviour for childhood illness in developing countries: a systematic review. *PLoS ONE* 9: e93427.
6. Memon KN, Shaikh K, Pandhiani BS, Usman G (2013) How do mothers recognize & treat pneumonia in their children at home? a study in union council jhudo, district mirpurkhas. *J Liaquat Uni Med Health Sci* 12: 3.
7. National Institute of Population Studies I (2012-13) Measure dhs, icf international, calverton, maryland, usa: pakistan Demographic and Health Survey.
8. Quadri F, Nasrin D, Khan A, Bokhari T, Tikmani SS, et al. (2013) Health care use patterns for diarrhea in children in low-income periurban communities of karachi, pakistan. *Am J Trop Med Hyg* 89: 49-55.
9. Mumtaz Y, Zafar M, Mumtaz Z (2014) Knowledge attitude and practices of mothers about diarrhea in children under 5 years. *J Dow Uni Health Sci* 8: 3-6.
10. UNICEF (2012) Pneumonia and diarrhoea: tackling the deadliest diseases for the world's poorest children.
11. Sur D, Manna B, Deb AK, Deen JL, Danovaro-Holliday MC (2004) Factors associated with reported diarrhoeaepisodes and treatment-seeking in an urbanslum of kolkata, India. *J Health Popul Nutr* 22: 130-138.
12. Hodgins S, Pullum T, Dougherty L (2013) Understanding where parents take their sick children and why it matters: a multi-country analysis. *Glob Health Sci Pract* 1: 328-356.
13. Mosites EM, Matheson AI, Kern E, Manhart LE, Morris SS, et al. (2014) Care-seeking and appropriate treatment for childhood acute respiratory illness: an analysis of demographic and health survey and multiple indicators cluster survey datasets for high-mortality countries. *BMC Public Health* 14: 1-8.
14. Anwar-ul-Haq HMD, Kumar R, Durrani SM (2015) Recognizing the danger signs and health seeking behaviour of mothers in childhood illness in Karachi, Pakistan. *Univ J Public Health* 3: 49-54.
15. Country-level programmes (2014) Lady health workers in pakistan improving access to health care for rural women and families.
16. Peers for Progress (2013) Program spotlight: pakistan's lady health workers: a national model for delivering primary healthcare and peer support.
17. Oxford Policy Management (2009) Lady Health Worker Programme: third party evaluation of performance. Oxford, UK.
18. Rabbani F, Mukhi AAA, Perveen S, Gul X, Iqbal SP, et al. (2014) Improving community case management of diarrhoea and pneumonia in district Badin, Pakistan through a cluster randomised study—the NIGRAAN trial protocol. *Implementation Science* 9: 1-10.
19. Ciccone MM, Aquilino A, Cortese F, Scicchitano P, Sassara M, et al. (2010) Feasibility and effectiveness of a disease and care management model in the primary health care system for patients with heart failure and diabetes (Project Leonardo). *Vasc Health Risk Manag* 6: 297-305.
20. Das JK, Lassi ZS, Salam RA, Bhutta ZA (2013) Effect of community based interventions on childhood diarrhea and pneumonia: uptake of treatment modalities and impact on mortality. *BMC Public Health* 13: 1-10.

21. Afsar HA QA, Younus M, Gulb A, Mahmood A (2003) Factors affecting unsuccessful referral by the Lady Health Workers in Karachi, Pakistan. *J Pak Med Assoc* 53: 521-528.
22. Zaman S, Ashraf RN, Martines J (2008) Training in complementary feeding counselling of healthcare workers and its influence on maternal behaviours and child growth: a cluster-randomized controlled trial in lahore, pakistan. *J Health Popul Nutr* 26: 210-222.
23. English M, Schellenberg J, Todd J (2011) Assessing health system interventions: key points when considering the value of randomization.
24. Sadruddin S, Khan IuH, Bari A, Khan A, Ahmad I, et al. (2015) Effect of community mobilization on appropriate care seeking for pneumonia in Haripur, Pakistan. *J Glob Health* 5: 010405.
25. Soofi S, Ahmed S, Fox MP, MacLeod WB, Thea DM, et al. (2012) Effectiveness of community case management of severe pneumonia with oral amoxicillin in children aged 2–59 months in Matiari district, rural Pakistan: a cluster-randomised controlled trial. *The Lancet* 379: 729-737.
26. Kasprzyk D (2005) Measurement error in household surveys: sources and measurement Chapter IX. In: *Household Sample Surveys in Developing and Transition Countries*. United Nations Publication, USA, E.05.XVII.6.