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Caregiver Experiences with the Introduction of Pentavalent Vaccines in Two Centers in Port Harcourt, South-South Nigeria

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Authors' contributions

This work was carried out in collaboration between all authors. Author OM designed the study, did literature search, performed the statistical analysis and wrote the first draft of the manuscript. Authors AT, AT and MA managed the analyses of the study and reviewed further drafts of the manuscript. All authors read and approved the final manuscript.

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ABSTRACT

Background: The Nigerian government, with support from the Global Alliance for Vaccine Initiative (GAVI) in 2012, began a three year phased roll out of the pentavalent vaccine as a replacement for DPT in the routine immunization schedule.
Aim: To assess client experiences with the use of pentavalent vaccines in two centers in Port Harcourt, Nigeria.
Methods: A cross-sectional study was carried out in January 2013. Caregiver-baby pairs who had index child six weeks to two years, who had received at least one dose of the pentavalent vaccine and had at least one other living child who took DPT, were interviewed using a semi-structured questionnaire. Chi squared test of significance was done with p-value set at 0.05.
Results: One hundred and eleven (111) caregivers were interviewed. Their mean age was 31±4.6 years, while mean age for babies was 16±8.6 weeks. Although 71 caregivers (76.3%) had received

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pentavalent vaccine information only 25 (22.5%) had seen pentavalent-specific Information Education and Communication (IEC) materials. Majority of caregivers 94 (84.7%) affirmed that they did not have to pay for vaccination. Fifty-three (53) caregivers (47.7%) preferred pentavalent vaccines to DPT while 35 (31.55%) were indifferent. Eighty-one (81) (73%) caregivers were satisfied with waiting times for vaccination and 62 (57.4%) experienced adverse events following immunization (AEFI) with pentavalent vaccination.

Conclusion: Pentavalent vaccines seem to have been well received in these centers with experiences of AEFI comparable to that of DPT. There is however need for appropriate vaccine-specific IEC materials to foster optimal uptake of pentavalent vaccines.

Keywords: Immunization; pentavalent vaccines; caregiver.

1. INTRODUCTION

Immunization is an important preventive health action as it offers protection against dangerous childhood diseases [1]. The Nigerian government, with support from the Global Alliance for Vaccine Initiative (GAVI) in June 2012, began a three year phased roll out of the pentavalent vaccine as part of her routine immunization schedule [2–4]. Pentavalent vaccines have replaced Dipteria, Pertusis and Tetanus (DPT) vaccines for routine immunization. Rivers State in Southern Nigeria was a beneficiary of the first phase. The pentavalent vaccine is a five-in-one vaccine consisting of diptheria, pertussis, tetanus, hepatitis B and haemophilus influenza type b vaccines [1]. These five vaccines are all given through a single dose as opposed to DPT, Hamophilus Influenza-b (Hib) and Hepatitis B (HBV) vaccines given as three separate injections. This reduces the number of clinic visits and discomfort for children [2]. Caregivers as used in this study refer to the parents or guardians who bring a baby for immunization. Caregiver-baby pair refers to the mother, father or guardian and his/her baby accessing immunization services.

As at 2011 almost all GAVI beneficiary countries had incorporated pentavalent vaccines into their routine immunization schedules. Estimates from GAVI projected that 72 GAVI eligible countries would have begun using this life- saving vaccine by 2013 in their routine immunization system [2–4]. It has also been projected that with the introduction of the pentavalent vaccine, nearly 400,000 cases of haemophilus influenza type B would be prevented with about 27,000 lives saved annually [3,5]. Many studies from other countries that have successfully deployed the vaccine demonstrate acceptable levels of safety and immunogenicity in addition to the already mentioned advantages [4,6–12]. One study however, called for caution in the use of pentavalent vaccines pointing out that its purported benefits might be over-rated [13]. Studies on caregiver experiences with the roll out of pentavalent vaccines in Nigeria are yet to be documented. This study therefore aims to describe caregiver experiences with pentavalent vaccines in two immunization centers in Port Harcourt, Rivers State, Nigeria.

2. MATERIALS AND METHODS

This study was carried out in the two immunization clinics of the University of Port Harcourt Teaching Hospital (UPTH). This is one of the two tertiary hospitals located in Port Harcourt the capital city of Rivers State, Nigeria. It is an 800 bed institution with 27 specialized departments. The two immunization clinics are directly managed by the Department of Community Medicine, UPTH. One of the centers is located within the hospital premises while the other is located at the Aluu Primary Health Center (PHC), about 10 km from the teaching hospital. The two immunization clinics cover the population within the catchment communities of the PHC and hospital and beyond the catchment area based on the strategic role of the tertiary institution within Rivers State. The two immunization clinics run five days a week (three days at UPTH and two days at PHC Aluu) providing free vaccination services in line with the National Program on Immunization (NPI) routine immunization schedule. Each clinic caters to an average of 50 infants each immunization session. Each session starts with registration of the babies and continues with the giving of health talks covering a variety of topics, and individual vaccinations activities.

We conducted a descriptive cross sectional study among caregiver-baby pairs receiving immunization services from Aluu PHC and UPTH immunization clinics. We included caregivers

who had index child/children older than six weeks but less than two years, who had received at least one dose of the pentavalent vaccine and had at least one other living child who took the previous DPT schedule. Caregiver-baby pairs with severely ill babies (temperature greater than 40 degrees celsius or on admission) were excluded from the study. Sample size was calculated based on the formula for single proportion [14] using a proportion of 51% from the 2011 Rivers State immunization coverage report, [15] at a precision of 10% and an upward adjustment of 10% to cater for non-response. Caregivers-baby pairs were recruited via announcements made during the health talks at the start of each clinic. Potential study participants were screened for eligibility and those who gave informed consent in writing were administered the questionnaire. An average of ten [10] caregiver-baby pairs per day over a period of eleven [11] clinic days were administered the questionnaire until sample size was reached.

A standard semi-structured interviewer administered questionnaire (The Satisfaction With Immunisation Service Questionnaire (SWISQ)) was pretested and adapted for eliciting responses from caregivers [16]. The questionnaire contained sections on socio-demographics, experiences with IEC, access, waiting time and adverse events following immunization with pentavalent vaccine. Data was analyzed using SPSS version 19. Chi squared test of significance was used to demonstrate sub group associations with p-value set at 0.05.

3. RESULTS AND DISCUSSION

3.1 Results

A total of 111 caregiver-baby pairs were studied. Mean age for babies was 16 weeks ±8.6 weeks. Of these 53 (47.7%) were male babies while 58 (52.3%) were females. Mean age of caregivers was 31 years ± 4.6. Most care givers were females 109 (98.2%) with only 2 (1.8%) being males. Other socio-demographic characteristics are as shown in Table 1.

Concerning the experiences of caregivers with information, education and communication (IEC) for pentavalent vaccines, most caregivers 93 (83.8%) reported receiving information about immunization. Of these numbers approximately two-thirds 71 (76.3%) received information about pentavalent vaccines. However, only 25 (22.5%) of the caregivers had come across IEC materials for pentavalent vaccines at the immunization centers. Despite this, only few of the caregivers 28 (25.2%) had any questions/concerns about immunization with pentavalent vaccines. Details are in Table 2.

When asked about access to pentavalent vaccines, only 34 caregivers (30.6%) reported challenges with accessing the immunization clinics. These challenges ranged from difficulty in getting transportation 20 (40.8%), and bad roads 21 (42.9%), to high cost of transportation 8 (16.3%). Most respondents 94 (84.7%) had never experienced stock outs of the pentavalent vaccines neither had they had to pay for the vaccines. Almost half of the respondents 53 (47.7%) preferred pentavalent vaccines to the DPT vaccine. Only 8 (7.2%) of caregivers preferred the DPT vaccine to pentavalent vaccine while 35 (31.5%) were indifferent and 9 (8.1%) didn't even understand the difference (Table 3). There were no associations found between either education or job category and preference between DPT and pentavalent vaccine ($p= 0.17$ *and* 0.9 respectively).

The study findings showed that 33 (29.7%) and 35 (31.5%) caregivers had experienced 30 minutes to 1 hour and between 1-2 hours waiting time respectively for the immunization clinics to commence vaccinations. Interestingly majority of these caregivers were satisfied with the length of time they had to wait. Similarly, 33 (29.7%) and 27 (24.3%) reported waiting 30 minutes- 1 hour and 1 to 2 hours respectively from the time vaccinations commenced to when their babies were attended to. Eighty-one caregivers (73%) were satisfied with these waiting time times. The suggestions they made about what should be done to reduce waiting times are outlined in Table 4.

There were no associations between either caregiver's education or current job and satisfaction with waiting times ($p=0.23$ *and* 0.38 respectively).

Sixty-two caregivers (57.4%) reported experiencing adverse events following immunization after a previous administration of pentavalent vaccine. These side effects include fever51 (82.3%), swelling and redness at vaccination site 21 (33.9%) and irritability 27 (43.5%). There were no associations between either caregiver's education or current job and

experience of these adverse events respectively (*p=0.87 and 0.55* respectively). There was also no association between number of previous doses of pentavalent vaccines taken and experience of AEFI *(p=0.64)* Table 5.

3.2 Discussion

The findings of this study indicate that most respondents were aware about vaccination in general and more specifically about pentavalent vaccines. Most caregivers had received health information through the health talks given by health workers at the immunization centers before the commencement of each immunization session. Majority of caregivers expressed satisfaction with the information received about pentavalent vaccines. Studies have shown that awareness about immunization in Nigeria is generally high [17–21]. Unfortunately, this does not always translate to correct knowledge. Many respondents in the study populations knew about immunization but a much smaller percentage had correct knowledge [17–21]. Study findings also indicated a dearth of IEC materials with pentavalent specific information at the study sites. This underscores the need for materials that give accurate information about pentavalent vaccines. Pamphlets, posters, cue-cards with pentavalent specific information will help to provide correct knowledge concerning these vaccines which will in turn contribute to better utilization and coverage rates [22].

Table 1. Socio-demographic characteristics of mother-baby pairs

	Frequency	Percentage (%)
Caregiver's age		
20-24	8	7.2
25-29	27	24.3
30-34	53	47.7
35-39	20	18
40-44	2	1.8
45-49	1	0.9
Caregiver's gender		
Male	2	1.8
Female	109	98.2
Parity		
Para 2	42	37.8
Para 3	32	28.8
Para 4	23	20.7
Para 5	8	7.2
Para 6	4	3.6
No response	2	1.8
Highest education of care-giver		
Primary	7	6.3
Secondary	34	30.6
Post-Secondary	5	4.5
Tertiary	55	49.5
Post Tertiary	10	9
Current daily job		
Working full time	40	36
Working part time	25	22.5
Unemployed	5	4.5
Looking for work	10	9
Full time housewife	30	27
Retired	1	0.9
Baby's Gender		
Male	53	47.7
Female	58	52.3
Baby's birth position		
2^{nd}	44	39.6
3^{rd}	33	29.7
4^{th}	21	18.9
5^{th}	10	9
6^{th}	2	1.8
No response	1	0.9

Table 2. Experiences of care-givers with information, education and communication

	Frequency	Percentage (%)
General information to mothers about immunization (n=111)		
Yes	93	83.8
No	15	13.5
Don't Know	3	2.7
Did the information include health education on the pentavalent vaccine? (n=93)		
Yes	71	76.3
No	19	20.4
Don't Know	3	3.3
Are you satisfied with the information they gave? (n=71)		
Yes	55	77.5
No	16	22.5
Are there IEC materials at the centers that tell you about the pentavalent vaccine? (n=111)		
Yes	25	22.5
No	85	76.6
No response	1	0.9
Did you have any questions/concerns about immunization with pentavalent vaccine? (n=111)		
Yes	28	25.2
No	75	67.6
No response	8	7.2
If yes to above, were these questions/concerns addressed by a health worker at this center? (n=28)		
Yes	15	53.7
No	13	46.4
Did you receive any information and advice from the nurse who gave the last pentavalent immunization your child received? (n=111)		
Yes	65	58.6
No	40	36.0
No response	6	5.4

Table 3. Experiences with access to pentavalent vaccines

	Frequency	Percentage
Challenges getting to the Immunization Center (n=111)		
Yes	34	30.6
No	75	67.6
No response	2	1.8
If yes to above, what are these challenges? (n=49 multiple responses)		
Difficulty in getting transportation	20	40.8
Bad roads	21	42.9
Cost of transportation	8	16.3
Was there any time that pentavalent vaccines were not available at any visit in the past one year? (n=111)		
Yes	15	13.5
No	94	84.7
No response	2	1.8
Have you ever had to pay to have pentavalent vaccines administered to your child?(n=111)		
Yes	15	13.5
No	94	84.7
No response	2	1.8
What is your preference between pentavalent and DPT vaccines? (n=111)		
I prefer Pentavalent vaccine	53	47.7
I prefer DPT	8	7.2
I am indifferent	35	31.5
I don't understand the difference	9	8.1

Table 4. Experiences with 'waiting time' for administration of pentavalent vaccines

Average length of waiting time before immunization services commenced during previous immunization visit (n=111)		
	Frequency	**Percentage**
< 30 mins	29	26.2
30mins - 1 hour	33	29.7
1 hour - 2 hours	35	31.5
> 2 hours	12	10.8
No response	2	1.8
Satisfaction with Waiting time before immunization services started(n=111)		
Yes	82	73.9
No	27	24.3
No response	2	1.8
Average waiting time between commencement of services and vaccination of your child at previous visit (n=111)		
< 30 mins	40	36
30mins - 1 hour	33	29.7
1 hour - 2 hours	27	24.3
> 2 hours	9	8.1
No response	2	1.8
Satisfaction with Waiting time before child was vaccinated (n=111)		
Yes	81	73
No	27	24.3
No response	3	2.7
If no to above what do you think should be done to reduce waiting time? (n=58 multiple responses)		
Start immunizing earlier	20	34.5
Reduce health talk time	3	5.2
Mothers should come early	16	27.6
Get more health workers to immunize	19	32.8

Table 5. Care givers experiences with adverse events following immunization

	Frequency	**Percentage (%)**
Any post immunization experiences not comfortable with? (n=108)		
Yes	62	57.4
No	45	41.7
Do not know	1	0.9
If yes to above, were these experiences after last pentavalent vaccine administration (n=62)		
Yes	62	100
No	0	0
What were these experiences? (multiple responses)		
Fever	51	82.3
Swelling	21	33.9
Irritability	27	43.5
Weakness	1	1.6
Vomiting	1	1.6

With regards to access to pentavalent vaccines, majority of caregivers attested to the availability of pentavalent vaccines at the immunization centers. No user fees were attached to the administration of the vaccine. This underscores the importance of ensuring sustained supply and

free access to these vaccines as a critical factor for facilitating uptake of immunization services. Studies have shown that non availability of vaccines impacts negatively on the uptake of immunization services [9,19,23]. The efforts of the National Program on Immunization (NPI), with support from GAVI, United Nations Children's Fund (UNICEF) and other partners, in sustaining availability and free access to immunization services has been identified as the likely reason for uninterrupted supply of pentavalent vaccines [24,25].

Almost half of the caregivers expressed a preference for pentavalent vaccines over DPT vaccines while a third of the care givers were indifferent to the new vaccines. The high proportion of caregivers who preferred pentavalent vaccines may be attributed to its obvious advantages as a combination of five vaccines rather than three and only one administration done using one site rather than multiple administration sites that was the case with DPT, HiB and HBV [7,10].

Satisfaction with waiting time while not specifically related to immunization with pentavalent vaccines is one indicator of the quality of immunization services being offered including pentavalent vaccines [16,26]. Majority of caregivers expressed satisfaction with the amount of time they waited for their babies to receive the pentavalent vaccines. This indicates that they were satisfied with the quality of services received from the immunization facilities offering pentavalent vaccines. This is in spite of the fact that two-third of caregivers wait between 30 minutes and two-hours before their babies receive pentavalent vaccines. However the number of caregivers who expressed dissatisfaction with waiting times, representing a third of the study population, indicates that more can be done to improve the quality of immunization services. Some suggestions proffered by study participants for reducing waiting time include starting immunization early and employing more health workers to attend to babies. These suggestions need to be taken seriously by the management of these facilities.

Adverse events following pentavalent vaccines have been found to be few and mild [6] with high immunogenic and safety profiles for pentavalent vaccines [4,8,10]. Adverse events following immunization (AEFI) with pentavalent vaccines were experienced by more than half of the babies in this study. However these were comparable with AEFI experienced following DPT immunization. A study done in Enugu Nigeria highlighted that a similar proportion of babies had AEFI following DPT vaccination [20]. The spectrum of adverse events identified by caregivers in this study is also similar to those experienced by babies who took DPT in a study done by Sharma et al in India [27].

The strengths of this study lie in the application of a standard questionnaire (SWISQ) to assess caregiver experiences within six months of the deployment of a new vaccine. The limitations of this study relate to the sample size and focus on only two immunization centers in the state. For this reason, further application of the SWISQ over a large sample of end users of pentavalent and other vaccines is recommended.

4. CONCLUSION

Pentavalent vaccines seem to be well accepted at the study sites with caregivers expressing satisfaction with services at the study centers. However there is need for the National Program on Immunization and its partners to produce and distribute appropriate vaccine-specific IEC materials at immunization clinics to aid health education activities and improve uptake of these vaccines. Improved staffing at immunization clinics, and better coordination of immunization activities, as suggested by the caregivers in this study, may further shorten waiting times and improve satisfaction with pentavalent and other vaccines. Experiences of AEFI in this study is comparable to that of DPT. Reporting of AEFIs need to be encouraged at these centers.

CONSENT

Study participants gave written informed consent by signing a consent form after the study had been explained to them. All study participants were assured of confidentiality and that they were free to decide not to respond to any aspect of the questionnaire without fear of negative consequences.

ETHICAL APPROVAL

Ethical clearance was obtained from the ethics committee of the institution before the study was undertaken.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. UNICEF DR. Immunisation and pentavalent vaccine [Internet].
   Available:http://www.unicef.org/republicadominicana/english/survival_development_12792.htm
2. Zuber PLF, El-Ziq I, Kaddar M, Ottosen AE, Rosenbaum K, Shirey M, et al. Sustaining GAVI-supported vaccine introductions in resource-poor countries. Vaccine [Internet]. 2011;29(17):3149–54. Available:http://www.ncbi.nlm.nih.gov/pubmed/21354249
3. GAVI. Nigeria launches pentavalent vaccine - 2012 - GAVI features - News - Library - GAVI Alliance [Internet].
   Available:http://www.gavialliance.org/library/news/gavi-features/2012/nigeria-launches-pentavalent-vaccine/
4. Bairwa M, Pilania M, Rajput M, Khanna P, Kumar N, Nagar M, et al. Pentavalent vaccine: A major breakthrough in India's Universal Immunization Program. Hum Vaccin Immunother [Internet]. Landes Bioscience; 2012;8(9):1314–6.
   Available:/pmc/articles/PMC3579914/?report=abstract
5. Gupta SK, Sosler S, Lahariya C. Introduction of Haemophilus influenzae type b (Hib) as pentavalent(DPT-HepB-Hib) vaccine in two states of India. Indian Pediatr [Internet]. 2012;49(9):707–9. Available:http://www.ncbi.nlm.nih.gov/pubmed/23024078
6. Sharma H, Yadav S, Lalwani S, Gupta V, Kapre S, Jadhav S, et al. A phase III randomized, controlled study to assess the immunogenicity and tolerability of DTPw-HBV-Hib, a liquid pentavalent vaccine in Indian infants. Vaccine [Internet]. 2011;29(13):2359–64.
   Available:http://www.ncbi.nlm.nih.gov/pubmed/21288803
7. Lagos R, Kotloff K, Hoffenbach A. Pentavalent parenteral combination vaccine containing diphtheria, tetanus, acellular pertussis, inactivated poliomyelitis and Haemophilus influenzae type. Pediatr Infect … [Internet]; 1998. [cited 2013 Dec 19].
   Available:http://scholar.google.com/scholar?q=Lagos+R,+Kotloff+K+Clinical+acceptability+and+immunogenicity+of+a+pentavalent+parenteral+combination+vaccine+containing+diphtheria,+tetanus,+acellular+pertussis,+inactivated+poliomyelitis+and+Haemophilus+influenzae+type+b+conjugate+antigens+in+two-,+four-+and+six-month-old+C&btnG=&hl=en&as_sdt=0,5#0
8. Yeh SH, Ward JI, Partridge S, Marcy SM, Lee H, Jing J, et al. Safety and immunogenicity of a pentavalent diphtheria, tetanus, pertussis, hepatitis B and polio combination vaccine in infants. Pediatr Infect Dis J. 2001;20(10):973–80.
9. Aspinall S, Traynor D, Bedford P, Hartmann K. Lot-to-lot consistency study of the fully liquid pentavalent DTwP-HepB-Hib vaccine Quinvaxem (®) demonstrating clinical equivalence, suitability of the vaccine as a booster and concomitant administration with measles vaccine. Hum Vaccin Immunother [Internet]. 2012;8(8):1109–18.
   Available:http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=3551883&tool=pmcenterz&rendertype=abstract
10. Merchant N, Waldrop J. The safety advantages of pentavalent vaccines. Nurse Pract [Internet]. 2012;37(4):48–53. Available:http://www.ncbi.nlm.nih.gov/pubmed/22430930
11. Madhi S, Cutland C, Jones S, Groome M, Ortiz E. Immunogenicity and safety of an acellular pertussis, diphtheria, tetanus, inactivated poliovirus, Hib-conjugate combined vaccine (Pentaxim™) and monovalent hepatitis B vaccine at 6, 10 and 14 weeks of age in infants in South Africa [Internet]. South African Medical Journal. Health and Medical Publishing Group. 2011;126–31. Available:http://www.ajol.info/index.php/samj/article/view/69739
12. Pancharoen C, Chotpitayasunondh T, Chuenkitmongkol S, Ortiz E. Long-term immunogenicity assessment of a DTaP-IPV//PRP-T vaccine given at 2, 4, 6 and 18-19 months of age, and immunogenicity and safety of a DTaP-IPV vaccine given as a booster dose at 4 to 6 years of age in Thai children. Southeast Asian J Trop Med Public Health [Internet]. 2012;43(3):687–98.

Available:http://www.ncbi.nlm.nih.gov/pubmed/23077849

13. Gupta M, Prinja S, Kumar D, Kumar R. Introducing pentavalent vaccine in EPI in India: a counsel for prudence in interpreting scientific literature. Indian J Med Res [Internet]. 2011;133:560–2; author reply 562–3. Available:http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=3121296&tool=pmcenterz&rendertype=abstract
14. Kirkwood BR. Essential medical statistics. 2nd ed. Malden, Mass: Blackwell Science; 2003.
15. RSMoH. Rivers-State-2011-Routine-Immunization-N-Surveillance-Report-.pdf [Internet]. Available:http://riversstatemoh.gov.ng/wp-content/uploads/2012/03/RIVERS-STATE-2011-ROUTINE-IMMUNIZATION-N-SURVEILLANCE-REPORT-.pdf
16. Tickner S, Leman P, Woodcock A. Design and validation of the Satisfaction With Immunisation Service Questionnaire (SWISQ). Vaccine [Internet]. 2010; Available:http://www.sciencedirect.com/science/article/pii/S0264410X10008662
17. Awodele O, Oreagba IA, Akinyede A, Awodele DF, Dolapo DC. The knowledge and attitude towards childhood immunization amongst mothers attending antenatal clinic in Lagos University Teaching Hospital. Tanzan J Health Res [Internet]. National Institute for Medical Research. 2010;12(3):172–7.

    Available:http://www.ajol.info/index.php/thrb/article/view/51112/43905
18. Kabir M, Iliyasu Z, Abubakar I, Gajida A. Knowledge, perception and beliefs of mothers on routine childhood immunization in a Northern Nigerian Village [Internet]. Annals of Nigerian Medicine. Medknow Publications. 2006;21–6.

    Available:http://www.ajol.info/index.php/anmed/article/view/38319
19. Ekure E, Esezobor C, Mukhtar-Yola M, Balogun M, Ojo O, Emodi I, et al. Community knowledge, attitude and practice of childhood immunization in Southwest Nigeria: Data from a Paediatric Association of Nigeria town hall meeting [Internet]. Nigerian Journal of Paediatrics. Paediatric Association of Nigeria. 2013;106–11.

    Available:http://www.ajol.info/index.php/njp/article/view/87096
20. Ekwueme O. Adverse events following immunization: Knowledge and experience of mothers in immunization centers in Enugu State, Nigeria [Internet]. Journal of College of Medicine. College of Medicine, University of Nigeria; 2009. [cited 2013 Dec 18].

    Available:http://www.ajol.info/index.php/jcm/article/view/44854
21. Omoleke I. A review of immunisation policy and the African child. Niger J Heal Biomed Sci [Internet]. Department of Physiology, College of Medicine of the University of Lagos. 2010;8(2).

    Available:http://www.ajol.info/index.php/njhbs/article/view/60948
22. Salako A, Oluwole F. An appraisal of immunisation in Nigeria: Towards improving coverage. Niger Hosp Pract [Internet]. CME Ventures. 2009;3(3-4). Available:http://www.ajol.info/index.php/nhp/article/view/45414
23. Oluwadare C. The social determinants of routine immunisation in Ekiti State of Nigeria. Stud Ethno-Med [Internet]; 2009. [cited 2013 Dec 31]. Available:http://www.krepublishers.com/02-Journals/S-EM/EM-03-0-000-09-Web/EM-03-1-000-2009-Abst-PDF/EM-03-1-049-09-057-Oluwadare-C/EM-03-1-049-09-057-Oluwadare-C-Tt.pdf
24. Lydon P, Levine R, Makinen M, Brenzel L, Mitchell V, Milstien JB, et al. Introducing new vaccines in the poorest countries: What did we learn from the GAVI experience with financial sustainability? Vaccine [Internet]. 2008;26(51):6706–16. Available:http://www.sciencedirect.com/science/article/pii/S0264410X08013777
25. Abdulkarim A, Ibrahim R, Fawi A, Adebayo O, Johnson A. Vaccines and immunization: The past, present and future in Nigeria [Internet]. Nigerian Journal of Paediatrics. Paediatric Association of Nigeria. 2011; 186–194.
    Available:http://www.ajol.info/index.php/njp/article/view/72382
26. Owino L, Irimu G, Olenja J, Meme J. Factors influencing immunisation coverage in Mathare Valley, Nairobi. East Afr Med J [Internet]. Kenya Medical Association. 2010;86(7).

Available:http://www.ajol.info/index.php/eamj/article/view/54146

27. Sharma H, Yadav S, Lalwani S, Kapre S, Jadhav S, Parekh S, et al. Antibody persistence of two pentavalent DTwP-HB-Hib vaccines to the age of 15-18 months, and response to the booster dose of quadrivalent DTwP-Hib vaccine. Vaccine [Internet]. 2013;31(3):444–7. Available:http://www.ncbi.nlm.nih.gov/pubmed/23196204

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