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Pediatric Immunization and Chemoprophylaxis in a Ugandan Sickle Cell Disease Clinic

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Abstract

Aim: We aimed to assess receipt of recommended care for young children with sickle cell disease (SCD) in a central SCD clinic in Kampala Uganda, focusing on standard vaccination and antibacterial and antimalarial prophylaxis.

Methods: A cross-sectional assessment of immunization status and timeliness and prescribed antibacterial and antimalarial prophylaxis was performed in a sample with SCD ages 7–71 months in Mulago Hospital SCD clinic. Government-issued immunization cards and clinic-issued visit records for prescribed prophylaxis were reviewed.

Results: Vaccinations were documented by immunization cards in 104 patients, mean age 31.7 months (range 3–70 months). Only 48 (46.2%) received all doses of each of the four recommended vaccine types, including pneumococcal 10-valent conjugate vaccine (PCV-10) which became available in 2014. Vaccination completion was associated with younger age and, for polio, maternal employment. PCV-10 series was completed in 54.8% of the sample, and 18.2% of those aged 48–71 months. Of children completing all vaccination types, an average 68.8% were immunized on time, defined as <60 days beyond the recommended age. Only 17 (13.5%) children were both fully and timely vaccinated. In an overlapping sample of 147 children, mean age 38.4 months (4–70 months), 81.6% had 1 documented prescription for penicillin and/or antimalarial prophylaxis.

Conclusions: Standardized vaccination, antibacterial and antimalarial protective measures for young children at this central SCD clinic were incomplete, especially PCV-10 for age ≥24 months, and often late. Child age but not general maternal demographics were associated with vaccination and chemoprophylaxis. Clinic-based oversight may improve timely uptake of these preventative measures.

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Conflicts of interests

The authors have no conflicts of interest to disclose.

Keywords

Immunisation; International child health; Haematology; Sickle cell disease

Introduction:

Sickle cell disease (SCD) is a highly prevalent blood disease in most of Sub-Saharan Africa. SCD affects 1–2% of births in Uganda.(1) High under-5 year mortality of these children(2) is often associated with infections from encapsulated bacteria, including *Streptococcus pneumoniae* (*S. pneumoniae*), *Hemophilus influenza b* (Hib), and malaria.(3–7). Vaccination is a key protective measure against *S. pneumoniae* in SCD.(8–10)

Vaccines, including pneumococcal 10-valent conjugate vaccine (PCV-10), antimicrobial prophylaxis with penicillin and anti-malarial prophylaxis are recommended for children with SCD by the World Health Organization (WHO). A dearth of national newborn hemoglobinopathy screening across African countries prevents many affected children from being identified early and prioritized for these prophylactic measures.(11)

Required childhood immunizations in Uganda are available at no cost from government-sponsored vaccination clinics.(12) Parents are issued vaccine cards for documenting immunizations. Demonstration of vaccinations is required for entry into school by 6 years of age. Centralized vaccination records are not maintained. In March 2014, the Ugandan Ministry of Health added PCV-10 to the schedule of required early childhood vaccines.(7, 13, 14) PCV-10 administration was extended to age two for some children with SCD due to their higher risk of pneumococcal infection.(6)

Our objectives were to determine whether children with SCD prior to school entry who were followed at a central SCD clinic: 1) Received all required childhood vaccinations; 2) Whether vaccinations were timely; and 3) If medications for antibacterial and antimalarial prophylaxis were prescribed. We reviewed records for receipt of required vaccinations and prescription of antibacterial (penicillin) and antimalarial prophylaxis for children from 0–71 months of age receiving care at the Mulago Hospital Sickle Cell Clinic (MHSCC). This large clinic is affiliated with the Makerere College of Health Sciences in Kampala, and is Uganda's largest and most well established SCD clinic.(15) Approximately 40–80 children with SCD are seen daily.

Materials and Methods:

This study was approved by the institutional review boards at Columbia University and Makerere University.

Between June-August 2016, parents or attendant adults with young children at the MHSCC were invited for study participation. Eligibility requirements included that the child: 1) Had a visit at MHSCC during the study period; 2) Was aged 71 months of age; 3) Documented hemoglobinopathy test result for SCD; 4) Did not require urgent medical care at that visit to avoid disruption of urgent care delivery, if needed; 5) Was not enrolled in a clinical trial that

included immunization assessment; 6) The immunization official record and/or family-held, clinic-issued visitation record was available for inspection. This notebook is used to record additional medical information, including receipt of antimicrobial and antimalarial prophylaxis. Patient's siblings were offered enrollment if they met all eligibility criteria. Children who had enrolled in an unrelated MHSCC-based trial conducted at the clinic were excluded, as their vaccination, antimicrobial and antimalarial prophylaxis were actively monitored as part of that trial. Including these patients could have skewed the numbers of children in our study who received vaccinations and prophylaxis. Some study data were collected from attendant adults who did not carry either of these documents; those data were reviewed separately to compare to those with cards.

Caretaker relationships were noted if attendant adults were not parents of the enrolled child. Consented adults were interviewed by a study nurse in the predominant local language, Luganda, or by a study member (CJC) in English, depending on the adult's choice.

After a consent form was signed, a study staff member reviewed the child's immunization card and clinic visitation record, adults answered a brief interviewed questionnaire about: age of child; area of residence (within or outside of Kampala); mother's level of education, employment status and religion. Study staff reviewed the two primary sources of data about vaccination and recorded prescription(s) for antimicrobial and antimalarial prophylaxis. To protect patient confidentiality, month and year of birth, but not date, were obtained for each child. For calculation of age, the 15th day of the birth month was assigned in lieu of the actual birth date.

Post-neonatal vaccination schedule required for school entry includes 10 doses, including: three dose series for each of polio, a pentavalent diphtheria, (pertussis, tetanus (DPT)/Hepatitis B/Hemophilus type B vaccine (HiB)), PCV-10, 1 doses of measles vaccine.(13) We excluded from analysis the neonatal vaccines BCG and the first polio vaccine dose, as their administration utilized a birth-related rather than immunization clinic-related process. The two-dose series of rotavirus vaccine was also excluded, as the vaccine had not been universally introduced to the vaccine panel.

We defined vaccine completion as having received all 10 of the required vaccinations. Since measles vaccine is scheduled at age 9 months, and each child's age was ± 15 days the actual date of birth, receipt of measles vaccine up to 10 months of age was coded as the appropriate age. Vaccinations were documented from the child's vaccination card. If not available at the clinic visit, the parent/caregiver was offered the option to send a photograph of the card to designated study personnel via mobile phone.

Vaccine timeliness was defined as receipt of all required doses of each vaccine type (polio, heptavalent, measles or pneumococcus) within 60 days of the upper limit of the recommended age range. This limit was chosen to adjust for recording child's age as ± 15 days from actual date of birth and for the possibility of delays resulting from holidays or other unavoidable postponements.

Antibacterial prophylaxis prescribed and dispensed in clinic was oral penicillin. For antimalarial prophylaxis, sulfadoxine/pyrimethamine was the agent most commonly

prescribed and dispensed in clinic, although another agent, co-trimoxazole, was occasionally used instead. Each was recorded by study staff as having been prescribed if written by a provider at least once within the child's clinic visitation record.

Statistical assessment was performed for each factor using descriptive chi square analysis.

Results:

A total of 227 adults accompanying young children to clinic were approached for study participation. Of these, 13 declined participation, or the child did not meet all eligibility criteria. An additional 33 were ineligible because the child was participating in an unrelated trial where vaccinations had been monitored.

Of the remaining 181 eligible children, immunization cards of 99 children were available for review at enrollment (Supplemental figure). Five additional children whose cards were transmitted as photograph via mobile phone were also enrolled. Of these 104 children, parents provided cards for 98 children (94.2%), with cards for six children provided by other adult family members (grandparents, aunts/uncles or siblings). Vaccination data on the remaining 77 children without an available immunization card were excluded; these children were not significantly older than those with cards ($p=0.072$).

For review of antibacterial and antimalarial prophylaxis, clinic visitation records were available for 147 patients at enrollment. Of these children, 139 (94.6%) records were provided by parents and eight from other family members. Some enrolled children ($n=33$) lacked available visitation record available for review and were excluded. One child was excluded because the parents could not recall month of birth. In all, 157 patients contributed data to the analysis, with 80 assessed for both vaccinations and prophylaxis. Nine children had siblings included in the sample.

Demographics:

Demographics data for study participants are shown in Table 1. Of 104 children with vaccinations records reviewed, a similar proportion was 0–23 (40.4%) or 24–47 (38.5%) months of age, while fewer (21.2%) were 48–71 months. An equal distribution of study patients lived within Kampala or in the surrounding area. Of the mothers of participating patients, a minority had completed university level schooling (18.3%), 50% worked outside of the home and a majority (72.1%) was Christian. For the 147 children with available chemoprophylaxis records, 70.7% also had their vaccination cards reviewed. Among the 147, 70.1% were 0–47 months of age. Other demographics were comparable between the two samples (Table 1).

Vaccination:

Of 104 children, 48 (46.2%) received all 10 of their required vaccine doses (Table 2, Figure 1). Completion was strongly correlated with younger age of the child ($p=0.0006$), with an especially strong association for completed pneumococcal vaccination ($p<0.0001$). Good vaccination coverage (84.6–92.3%) was achieved for polio, pentavalent vaccine and measles. In contrast, PCV-10 vaccination was completed in 54.8% of children surveyed. Children 0–

23 months received PCV-10 at the same proportion as the other vaccines. However, only proportion who received pneumococcal vaccine precipitously dropped off starting at ages 24–47 months, with only 18.2% for ages 48–71 months. Beyond age, the only correlation between vaccination and demographic factors assessed was in receipt of polio vaccine and maternal employment. A trend for a relationship to maternal employment was also seen for pentavalent vaccination but not for measles. No significant correlations were found with area of residence, maternal education or religion.

Vaccine Timeliness:

Timeliness was assessed for children who had completed all 10 doses of the required vaccines, and all required doses for each of the four vaccine types assessed: polio, pentavalent vaccine, PCV-10 and measles (Table 3). Of 104 children, only 17 (13.5%) had been both fully and timely vaccinated. There were 42 children who received all 10 doses of the required vaccines. Of these, 40.5% had timely receipt. Timely vaccinations were recorded for 61.4–73.7% for each completed vaccine type, with a mean of 68.6%. No demographic factors met significance for association with vaccination timeliness, nor was timeliness associated with any linear trends by age.

Antibacterial and antimalarial prophylaxis:

Documentation was assessed for least one prescription of each of the two medication types, prophylactic antibacterial and/or antimalarial, in their clinic visitation records (Table 4). The same proportion (82%) was observed for each type of medication. Younger age was significantly correlated with antibacterial prophylaxis ($p=0.03$), while residence outside of Kampala was correlated with higher proportion of antimalarial prophylaxis ($p=0.038$).

Discussion:

Vaccination and chemoprophylaxis against infectious diseases are part of standardized international recommendations for care of children with SCD.(2, 16, 17). Using written records to document vaccinations in an unselected sample of children receiving care in a central SCD clinic in Kampala, completion levels of over 80% were found for three of four different vaccine types. Maternal employment was associated with receipt of all of the non-pneumococcal vaccines except for measles, perhaps due to broader access to measles vaccine due to periodic campaigns. Complete post-neonatal vaccination, requiring a total of 10 doses, often was not achieved. Pneumococcal vaccination was far less likely than the other vaccines, especially for those >24 months of age. Other than PCV-10, good immunization levels may be attributable to Uganda's access to free government-sponsored immunizations clinics, school entry requirements by age 6 years, and periodic polio and measles vaccination campaigns.(12, 18) Lack of association with maternal demographics, other than polio vaccination with maternal employment, supports the concept of vaccine availability.

Failure of completion of required vaccination was primarily due to low coverage of PCV-10. These findings may reflect the recent introduction of pneumococcal vaccine into the schedule, with subsequent low coverage, especially for children who were 2 years of age

when the vaccine became available in public immunization clinics and thus were ineligible for receipt.(13)

Overall proportion of vaccine completion in our sample, excluding PCV-10, was 88–96%, with levels of 83–93% by age 23 months. These latter levels are somewhat lower than the 2016 national infant immunization coverage in Uganda reported by WHO and UNICEF. (19) Vaccination levels in our modest sample could have been affected by maternal and other socio-economic factors,(18) or impact from the chronic illness of SCD.

Regarding vaccine timeliness, approximately one third of children with complete vaccination had late receipt of each of the vaccine types, defined as >60 days from recommended age. Analysis of vaccination timeliness revealed that timely receipt of all or any vaccines or single type of vaccine were not statistically associated with child's age or other factors. These findings suggest that system-wide issues prevented timely vaccination, such as potential barriers to access such as parents not knowing the schedule of vaccine delivery for their child and/or other social factors affecting vaccine completion.

For antibacterial and antimalarial prophylaxis, most children had at least one recorded instance of a SCD clinic-based prescription for chemoprophylaxis. Associations with younger age and residence outside of Kampala suggests there may be evolving provider practices. The rationale for the higher proportion of antimalarial prophylaxis seen for children residing outside of Kampala is unclear, perhaps reflecting provider concerns about higher rural mosquito density. However, we were unable to document actual or continuous use of these medications. Impediments to adherence could arise from medication stock-outs at the clinic pharmacy distribution site and non-adherence to the recommended daily doses.

Our findings resemble those of a recent report of vaccine uptake among a general pediatric sample in a Kampala-based or rural general pediatric sample without known chronic illness, (12, 20) a 2015 WHO-based assessment of pediatric measles vaccination in Uganda,(21) and also a 31-country assessment performed in 31 other countries in the region.(22) Similar to our study, the latter report also relied on immunization card inspection to confirm vaccine receipt and timing, and uncovered a high prevalence of late vaccine administration. A larger 2015 Ugandan study reported vaccine completion at a level similar to our study,(18) although written vaccine documentation was reviewed in only half of that sample. Similar levels of vaccination, including pneumococcal vaccine, and antimicrobial and anti-malarial prophylaxis were reported in a sample of children with SCD from Kinshasa, Democratic Republic of Congo. In contrast to our study, the Kinshasa study did not report vaccine documentation.(23) Pneumococcal vaccination level of <1% was reported in a clinic sample of children with SCD in Northern Tanzania, underscoring that its penetrance outside of capital cities may be even lower.(24)

Newborn hemoglobinopathy pilot screening began in Kampala in late 2015. As elsewhere in the region,(25) infant screening is intended to support early identification SCD, with the intent of enabling initiation of timely and complete immunization and appropriate antimicrobial and antimalarial prophylaxis.(2) Interventions that may promote complete and timely vaccine coverage for children with SCD include: 1) Review of immunization status at

SCD clinic visits to identify missing vaccines and referral to immunization clinics; 2) Approval from the central health authority to allow immunization clinics to administer pneumococcal vaccine to non-immunized children with SCD < 2 years of age; 3) Availability of and ability to administer vaccines, especially PCV-10, at MHSCC and other SCD clinics in Uganda; and 4) Centralized vaccination tracking and provider notification regarding patients with missing vaccines.

Despite early diagnosis through newborn screening and systematic vaccine tracking in the U.S., incomplete pediatric pneumococcal vaccination also occurs in U.S. SCD patients.(26) Uneven adherence to daily penicillin prophylaxis in young children with SCD in the U.S. has also been identified.(27) Collectively, these findings suggest that enhanced focus on individual patients' vaccination and anti-microbial prophylaxis status may be necessary to achieve maximum protection against infectious pathogens.

A major limitation of our study sample was its modest sample size. Another limitation was the unequal distribution across age categories. Other limitations included inexact birth dates. The use of a 60-day window after the recommended latest age for immunization used may have tempered this limitation, but may also have been too lenient. Demographic data focused only on the mother. Only a subset of parents had brought their children's vaccination cards to clinic, and subtle differences in demographic factors between that group and the entire clinic sample may have existed. Many more parents brought their children's clinic visitation records with written chemoprophylaxis prescriptions, especially for the older children in this sample. Even with a written prescription, no confirmation of whether and how often parents had filled prescriptions was possible.

Overall, fewer than half of the pre-school children treated at the central SCD clinic in Kampala received all 10 of the required post-neonatal doses, and many vaccines were administered late. Our findings suggest that many of these children, already highly susceptible to complications from infection, have sub-optimal protection against common infectious diseases despite available and efficacious interventions. The largest challenge to achieving full vaccination was the modest levels of pneumococcal vaccination, especially for children >age 24 months. These findings suggest that younger children with SCD may be followed more closely than older children for receipt of standard, available measures for infection prevention. Another interpretation is that vaccination rates may be rising. Prescription antimicrobial and antimalarial prophylaxis was high, but did not include complete and timely vaccination and family support for continuous availability and use of antimicrobial prophylaxis could be improved. For children with SCD, enhanced vaccine oversight in clinical care and accessibility for older children may improve the uptake and impact of these preventative measures.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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References

1. Ndeezi G, Kiyaga C, Hernandez AG, Munube D, Howard TA, Ssewanyana I, et al. Burden of sickle cell trait and disease in the Uganda Sickle Surveillance Study (US3): a cross-sectional study. *Lancet Glob Health*. 2016;4(3):e195–200. [PubMed: 26833239]
2. Makani J, Soka D, Rwezaura S, Krag M, Mghamba J, Ramaiya K, et al. Health policy for sickle cell disease in Africa: experience from Tanzania on interventions to reduce under-five mortality. *Trop Med Int Health*. 2015;20:184–7. [PubMed: 25365928]
3. Diagne I, Moreira C, Camara B, Diouf S, Ba M, Sarr M, et al. Les syndromes drépanocytaires majeurs en pédiatrie à Dakar (Sénégal). *Archives de Pédiatrie*. 2000;7:16–24. [PubMed: 10668081]
4. Makani J, Mgaya J, Balandya E, Msami K, Soka D, Cox SE, et al. Bacteraemia in sickle cell anaemia is associated with low haemoglobin: a report of 890 admissions to a tertiary hospital in Tanzania. *Br J Haematol* 2015.
5. Williams TN, Uyoga S, Macharia A, Ndila C, McAuley CF, Opi DH, et al. Bacteraemia in Kenyan children with sickle-cell anaemia: a retrospective cohort and case-control study. *Lancet*. 2009;374(9698):1364–70. [PubMed: 19747721]
6. Ramakrishnan M, Moisi JC, Klugman KP, Iglesias JMF, Grant LR, Mpoudi-Etame M, et al. Increased risk of invasive bacterial infections in African people with sickle-cell disease: A systematic review and meta-analysis. *The Lancet Infectious Diseases*. 2010;10:329–37. [PubMed: 20417415]
7. Lindstrand A, Kalyango J, Alfven T, Darenberg J, Kadobera D, Bwanga F, et al. Pneumococcal Carriage in Children under Five Years in Uganda-Will Present Pneumococcal Conjugate Vaccines Be Appropriate? *PLoS One*. 2016;11(11):e0166018. [PubMed: 27829063]
8. Ellison AM, Ota KV, McGowan KL, Smith-Whitley K. Pneumococcal bacteremia in a vaccinated pediatric sickle cell disease population. *Pediatr Infect Dis J* 2012;31(5):534–6. [PubMed: 22228232]
9. De Montalembert M, Abboud MR, Fiquet A, Inati A, Lebensburger JD, Kaddah N, et al. 13-valent pneumococcal conjugate vaccine (PCV13) is immunogenic and safe in children 6–17 years of age with sickle cell disease previously vaccinated with 23-valent pneumococcal polysaccharide vaccine (PPSV23): Results of a phase 3 study. *Pediatr Blood Cancer*. 2015;62(8):1427–36. [PubMed: 25810327]
10. Davies EG, Riddington C, Lottenberg R, Dower N. Pneumococcal vaccines for sickle cell disease. *Cochrane Database Syst Rev* 2004(1):CD003885.
11. Akingbola TS, Tayo BO, Salako B, Layden JE, Hsu LL, Cooper RS, et al. Comparison of patients from Nigeria and the USA highlights modifiable risk factors for sickle cell anemia complications. *Hemoglobin*. 2014;38:236–43. [PubMed: 24941131]
12. Babirye JN, Engebretsen IM, Makumbi F, Fadnes LT, Wamani H, Tylleskar T, et al. Timeliness of childhood vaccinations in Kampala Uganda: a community-based cross-sectional study. *PLoS One*. 2012;7(4):e35432. [PubMed: 22539972]
13. UNEPI. Immunization Guidelines by UNEPI 2016.
14. Gavi. Pneumococcal AMC Annual Report. 2016.
15. Green NS, Mathur S, Kiguli S, Makani J, Fashakin V, LaRussa P, et al. Family, Community, and Health System Considerations for Reducing the Burden of Pediatric Sickle Cell Disease in Uganda Through Newborn Screening. *Glob Pediatr Health*. 2016;3:2333794X16637767.
16. Yawn BP, Buchanan GR, Afenyi-Annan AN, Ballas SK, Hassell KL, James AH, et al. Management of sickle cell disease: summary of the 2014 evidence-based report by expert panel members. *JAMA* 2014;312(10):1033–48. [PubMed: 25203083]
17. Organization WH. Sickle-cell anaemia. 2006.
18. Bbaale E Immunization in Uganda. *Journal of Health, Population and Nutrition*. 2015;31:118–29.

19. UNICEF Infant immunization rates. 2017.
20. Vonasek BJ, Bajunirwe F, Jacobson LE, Twesigye L, Dahm J, Grant MJ, et al. Do Maternal Knowledge and Attitudes towards Childhood Immunizations in Rural Uganda Correlate with Complete Childhood Vaccination? PLoS One. 2016;11(2):e0150131. [PubMed: 26918890]
21. Masresha BG, Dixon MG, Kriss JL, Katsande R, Shibeshi ME, Luce R, et al. Progress Toward Measles Elimination - African Region, 2013–2016. MMWR Morb Mortal Wkly Rep 2017;66(17): 436–43. [PubMed: 28472026]
22. Akmatov MK, Mikolajczyk RT. Timeliness of childhood vaccinations in 31 low and middle-income countries. J Epidemiol Community Health. 2012;66(7):e14. [PubMed: 21551179]
23. Aloni MN, Nkee L. Challenge of managing sickle cell disease in a pediatric population living in kinshasa, democratic republic of congo: a sickle cell center experience. Hemoglobin. 2014;38:196–200. [PubMed: 24669956]
24. Saidi H, Smart LR, Kamugisha E, Ambrose EE, Soka D, Peck RN, et al. Complications of sickle cell anaemia in children in Northwestern Tanzania. Hematology. 2016;21(4):248–56. [PubMed: 26868490]
25. McGann PT, Ferris MG, Ramamurthy U, Santos B, de Oliveira V, Bernardino L, et al. A prospective newborn screening and treatment program for sickle cell anemia in Luanda, Angola. American Journal of Hematology. 2013;88:984–9. [PubMed: 24038490]
26. Beverung LM, Brousseau D, Hoffmann RG, Yan K, Panepinto JA. Ambulatory quality indicators to prevent infection in sickle cell disease. Am J Hematol 2014;89(3):256–60. [PubMed: 24779032]
27. Patel NG, Lindsey T, Strunk RC, DeBaun MR. Prevalence of daily medication adherence among children with sickle cell disease: a 1-year retrospective cohort analysis. Pediatr Blood Cancer. 2010;55(3):554–6. [PubMed: 20658630]

What is already known on this topic?

1. Primary immunizations in the general pediatric population in Sub-Saharan Africa are incomplete, and is associated with child and maternal demographics;
2. For children with sickle cell disease in the region, preventative measures against common infectious diseases are paramount for improved survival.
3. Recommended care of children with sickle cell disease worldwide includes standard vaccination, including with anti-pneumococcal vaccine and prophylactic antibiotic and anti-malarial medications.

What this paper adds?

Overall – in a non-selected clinic sample of preschool patients in one of the large established sickle cell clinics in Africa, we demonstrate that standard preventative care was not optimized in children less than 6 years of age:

1. Receipt of standardized vaccinations, including anti-pneumococcal vaccine, is incomplete despite free access through government-sponsored immunization clinics.
2. Vaccinations were often received more than 60 days late.
3. Despite the importance of standard of antimicrobial and antimalarial prophylaxis, these medications were incompletely prescribed.

Figure 1: Prevalence of complete immunization by vaccine type and age range for children under 6 years (72 months) of age.

DTP-Hep B-Hib: Diphtheria-Tetanus-Pertussis, Hepatitis B, Hemophilus influenza type B

PCV:Pneumococcal conjugate vaccine

Table 1.

Demographics of the pediatric sample from the Mulago Hospital Sickle Cell Disease clinic, by child age, residence and maternal demographics.

	Vaccinated data (n=104)	Chemoprophylaxis data (n=147)
Child's age (months)		
0–23	42 (40.4)	56 (38.1)
24–47	40 (38.5)	47 (32.0)
48–71	22 (21.2)	44 (29.9)
Residence		
Kampala	47 (45.2)	69 (46.9)
Other	57 (54.8)	78 (53.1)
Maternal Education Level		
Primary school	33 (31.7)	49 (33.3)
Secondary school	51 (49.0)	72 (49.0)
University	19 (18.3)	26 (17.7)
Unknown/no response	1 (1.0)	0 (0.0)
Maternal Employment Status		
Yes	52 (50.0)	82 (55.8)
No	52 (50.0)	64 (43.5)
Unknown/no response	0 (0.0)	1 (0.7)
Maternal religion		
Christian	75 (72.1)	112 (76.2)
Muslim/Other	29 (27.9)	35 (23.8)

Education includes some schooling or completion at each level.

Table 2.
Receipt of required vaccinations in a pediatric sample from the Mulago Hospital Sickle Cell Disease clinic, by demographics. Overall, high levels of vaccination found except for pneumococcal (PCV-10). Polio vaccination associated with maternal employment, while receipt of PCV-10 inversely correlated with child's age.

Vaccine requirements were established by the Ugandan Ministry of Health, following WHO standards (ref. 13). Percentages refer to the total number who received all of recommended doses for each vaccine type. Demographic features are compared within each category.

	All 10Vaccines(%)	P value	All 3 Polio (%)	P value	All 3 PV (%)	P value	All 3 PC (%)	P value	Measles (%)	P value
Number fully vaccinated	48 (46.2)		88 (84.6)		95 (91.3)		57 (54.8)		96 (92.3)	
Child's Age (months)		0.0006		0.65		0.51		<0.0001		0.17
0–23	27 (64.3)		35 (83.3)		39 (92.9)		35 (83.3)		36 (85.7)	
24–47	18 (45.00)		33 (82.5)		35 (87.5)		18 (45.0)		38 (95.0)	
48–71	3 (13.6)		20 (90.9)		21 (95.4)		4 (18.2)		22 (100.0)	
Residence		0.09		0.33		0.96		0.09		0.23
Kampala	26 (55.3)		38 (80.8)		43 (91.5)		30 (63.8)		45 (95.7)	
Outside Kampala	22 (38.6)		50 (87.7)		52 (91.2)		27 (47.4)		51 (89.5)	
Maternal Education *		0.07		0.17		0.17		0.37		0.54
Up to primary school	12 (36.4)		25 (75.8)		28 (84.8)		16 (48.5)		30 (90.9)	
Up to secondary school	22 (43.1)		44 (86.3)		47 (92.2)		27 (52.9)		46 (90.2)	
Up to university	13 (68.4)		18 (94.7)		19 (100.0)		13 (68.4)		19 (100.0)	
Mother's Employment Status		1.00		0.007		0.08		0.55		1.00
Employed	24 (46.2)		49 (94.2)		50 (96.2)		27 (51.9)		48 (92.3)	
Unemployed	24 (46.2)		39 (75.0)		45 (86.5)		30 (57.7)		48 (92.3)	
Maternal Religion		0.25		0.78		0.70		0.35		0.53
Christian	32 (42.7)		63 (84.0)		69 (92.0)		39 (52.0)		70 (93.3)	
Muslim	16 (55.2)		25 (86.2)		26 (89.7)		18 (62.1)		26 (89.7)	

Data in bold represent p value < 0.05.

* 1 missing value

Vaccine abbreviations: PV: Pentavalent (DPT-HepB-Hib) PC: Pneumococcal (PCV-10)

Table 3.

Timeliness of vaccination of children with sickle cell disease, for those who received all required doses of each vaccine type, by child age, residence and maternal demographics. Only modest levels of timeliness were found, defined as receipt within 60 days of scheduled vaccination, without association by demographics.

Of children completing doses for each of the four vaccine types, a mean of 61.8% vaccine types were received within 60 days beyond the required age. Demographic features are compared within each category.

	All 10 Required n = 42 (%)	P value	3 Polio n = 88 (%)	P value	3 PV n = 95 (%)	P value	3 PCV-10 n = 57 (%)	P value	Measles, n = 88 (%)	P value
Total with timely vaccination	17 (40.5) *		54 (61.4)		70 (73.7)		39 (68.4)		60 (68.2)	
Child's Age (months)		0.06		0.96				0.92		0.07
0-23	9 (42.8)		25 (71.4)		29 (74.4)		26 (74.3)		22 (78.6)	
24-47	5 (27.8)		24 (72.7)		25 (71.4)		9 (50.0)		21 (55.3)	
48-71	3 (100.0)		15 (75.0)		16 (76.2)		4 (100.0)		17 (77.3)	
Residence		0.86		0.51				0.28		0.76
Kampala	10 (41.7)		29 (76.3)		34 (79.1)		20 (66.7)		28 (66.7)	
Outside Kampala	7 (38.9)		35 (70.0)		36 (69.2)		19 (70.4)		32 (69.6)	
Maternal Education		0.17		0.11				0.31		0.70
Up to primary school	4 (40.0)		15 (60.0)		18 (64.3)		10 (62.5)		19 (67.8)	
Up to secondary school	5 (27.8)		32 (72.7)		35 (74.5)		18 (66.7)		25 (62.5)	
Up to university	8 (61.5)		16 (88.9)		16 (84.2)		10 (76.9)		16 (84.2)	
Mother's Employment Status		0.57		0.51				0.31		0.38
Employed	9 (45.0)		37 (75.7)		39 (78.0)		20 (74.1)		29 (65.9)	
Unemployed	8 (36.4)		27 (69.2)		31 (68.9)		19 (63.3)		31 (70.5)	
Maternal religion		0.66		0.66				0.93		0.16
Christian	12 (42.8)		45 (71.4)		51 (73.9)		29 (74.4)		42 (65.6)	
Muslim	5 (35.7)		19 (76.0)		19 (73.1)		10 (55.6)		18 (75.0)	

Vaccine abbreviations: PV: Pentavalent (DPT-HepB-Hib) PC: Pneumococcal (PCV-10)

* Chi-square test may not be a valid test for those who received all 10 vaccines due to insufficient size.

Receipt of required chemoprophylaxis in pediatric sample from the Mulago Hospital Sickle Cell Disease Clinic, by child age, residence and maternal demographics (N=147). Younger children and those residing outside of Kampala had higher levels of recorded chemoprophylaxis.

Table 4.

	Antibacterial prophylaxis (%)	P values	Antimalarial prophylaxis (%)	P values
Total with prophylaxis	N=120 (82)		N=121 (82)	
Child's Age (months)		0.03		0.92
0–23	50 (89.3)		47 (83.9)	
24–47	39 (83.0)		38 (80.8)	
48–71	31 (70.4)		36 (81.8)	
Residence		0.16		0.038
Kampala	53 (76.8)		52 (75.4)	
Outside Kampala	67 (85.9)		69 (88.5)	
Maternal Education		0.61		0.95
Up to primary school	42 (85.7)		41 (83.7)	
Up to secondary school	58 (80.6)		59 (81.9)	
Up to university	20 (76.9)		21 (80.8)	
Mother's Employment Status		0.62		0.65
Employed	68 (82.9)		69 (84.1)	
Unemployed	51 (79.7)		52 (81.2)	
Maternal religion		0.83		0.68
Christian	91 (81.2)		93 (83.0)	
Muslim	29 (82.8)		28 (80.0)	

Data in bold represent p value < 0.05.