Out of pocket expenditure by snakebite victims in Ghana

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# Abstract

# Introduction

Worldwide, snakebite victims are often the vulnerable poor rural folks1,2. Inequitable distribution of healthcare facilities and the lack of appropriate care exacerbate the plight of snakebite victims. An estimated 125,000 to 500,000 cases of snakebites occur annually in Africa even though most of them are thought to be undocumented3. About 95,000 deaths occur globally annually from snakebites with only about 300,000 survivors4. The survivors are often left with permanent disabilities or disfigurement and are often left stigmatized and destitute5. Life-threatening effects of snakebite envenoming include shock, spontaneous systemic bleeding, paralysis involving respiratory and skeletal muscles, and can also lead to acute renal failure6. Amputations, disfigurement, mutilations, and tissue necrosis are common complications of snakebite envenoming7,8. The high morbidity and mortality associated with the bites result in high socioeconomic consequences6 for individuals and families.

Victims of snakebites require a range of services, from antivenom administration to supplementary medical interventions such as cardio-respiratory and/or fluid resuscitation; airway intubation; mechanical ventilation; hemodialysis; wound debridement and reconstructive surgery; physiotherapy; and other rehabilitation services6. Unfortunately, these services are not usually available in primary care health settings (Community-based Health Services and Planning) in rural Ghana where a lot of the cases occur. In situations where they are available, they are not cheap. Snakebite victims therefore often start by going to traditional healers or use ineffective or unproven methods before seeking hospital care, resulting in delays in the administration of antivenoms which results in complications and possible mortality9,10.

The socioeconomic impact of snakebite is under-appreciated around the world, even though the impacts transcend individuals and families into communities and the health systems11. It is estimated the burden to some families to be as much as their 12-year salary12. The average cost for an effective treatment, based on recommended doses is USD 124 in Sub-Saharan Africa13, 4 times the minimum monthly wage in Ghana then**Africapay.org?**. In Sri Lanka, 79% of snakebite victims suffered an economic loss following a snakebite with a median Out-of-Pocket Payments(OOP) of USD 11 and a median estimated loss of income of USD 28.57 and USD 33.21 for those in employment or self-employment, respectively2. The total estimated OOP in the country was USD 1,981,6992. Additionally, family members also lost income to help care for patients. In India, 53.5% of snakebite victims spent 1 to 6 months or more at home after the bite, 43.5% of the victims had to sell an asset due to snakebites, with the majority having to sell their farm crops. Four of the victims had to forfeit their education because of the bite, an unfortunate incident that must not happen. The annual estimated total number of DALYs was 11,101 to 15,076 per year for envenoming following snakebite12.

The health system cost for Sri Lanka is estimated to be USD 10,260,652 annually2. Using the conservative estimate from13, then multiplying by the average yearly incidence in Ghana (9600)14, it can be estimated that the government of Ghana spends an average of USD 1,190,400 on antivenoms since they are free in Ghana.

To the best of our knowledge, no studies exist in sub-Saharan Africa which report the OOP experienced by snakebite victims. The study, therefore, reports the direct OOP by snakebite victims in rural Ghana.

# Methods

## Ethics statement

This study has ethical approval from the Ghana Health Service. The reference number for it is GHS-ERC010/03/20. It is part of the Snakebite Incidence Treatment and Effect in Ghana (SnakebITE) project being run by the author[]. Permission was also sought from the administration of the hospital to extract records from their electronic health records (EHR).

## Data extraction

The OOP by snakebite victims data were extracted from the electronic health records database of the hospital. The hospital has used the system since 2015. Author[] can script in Transactional-Structured Query Language (T-SQL) and extracted the records from the database in the presence of the hospital I.T/Health Information Officer. A total of 1391 were retrieved from the database.

Currency conversion was done with data from15. The average yearly rate was taken from the website and used to compute the OOP for each payment made by the patient while on the admission for the snakebite diagnosis.

## Data analysis

Statistical analysis was done with the R Statistical Software (version 4.2) with the aid of third party packages16,17,,18,,19,20,21. Frequencies and percentages were recorded for the count variables and the median [interquartile range (IQR)] was reported for the continuous variables. A Generalized Linear Model (GLM) was fit on the data to determine the predictors of OOP among the victims of snakebite at the hospital. The payment method (Insured/Cash & Carry: A term in Ghana for patients without an insurance), year, outcome, length of stay was selected through stepwise backwards elimination method until such a time the model AIC failed to reduce significantly. Variable interaction was done for the year and length of stay, and the payment method and the year variables.

# Results and analysis

We report cases of snakebites reported in a public hospital from 2016 to 2019 (Table ). A total of 1,391 records were retrieved from the EHR. The median (IQR) age of the victims was 20 (13, 33). Most, [907 (65%)], of the snakebite victims were males. Most of the cases were reported in 2018 405 (29%) than other years. The primary occupation of most of the victims was farming 604 (43%), 256 (18%) were students, and 63 (4.5%) engaged in other occupations. The primary occupation of 410 (29%) of the victims were not indicted in the EHR. A total of 892 (64%) were reported in the harmattan season and 519 (37%) was recorded during periods where there was rather little farming activity and mainly irrigation farming and hunting. Most of the victims, [1,375 (99%)], were treated successfully at the hospital and were discharged. The median (IQR) length of stay of the victims at the hospital was 3.00 (2.00, 4.00).

**Table** **:** Demographic characteristics of snakebite victims extracted from EHR

| **Characteristic** | **N = 1,391**1 |
| --- | --- |
| Age | 20 (13, 33) |
| Gender |  |
| Female | 484 (35%) |
| Male | 907 (65%) |
| year |  |
| 2016 | 311 (22%) |
| 2017 | 344 (25%) |
| 2018 | 405 (29%) |
| 2019 | 331 (24%) |
| Season |  |
| Dry | 892 (64%) |
| Rainy | 499 (36%) |
| NHIS |  |
| No | 624 (45%) |
| Yes | 767 (55%) |
| Occupation |  |
| Farmer | 604 (43%) |
| House Wife | 42 (3.0%) |
| Student | 256 (18%) |
| Trader | 16 (1.2%) |
| Unknown | 410 (29%) |
| Other | 63 (4.5%) |
| Activity related to farming |  |
| Harvesting | 195 (14%) |
| Irrigation/hunting | 519 (37%) |
| Land preparation | 297 (21%) |
| Farming | 380 (27%) |
| Outcome |  |
| Died | 16 (1.2%) |
| Discharged Alive | 1,375 (99%) |
| Length of stay | 3.00 (2.00, 4.00) |
| Unknown | 286 |
| 1Median (IQR); n (%) | |

## OOP for snakebite victims

The total OOP from 2016 to 2019 at the hospital was USD 61,224 (Table ) of which USD 12,274 were payments made by victims that had an insurance cover (presumed to be the Nation Health Insurance Service [NHIS]) at the time of admissions and USD 48,949 were paid by victims without insurance cover. The median (IQR) amount paid by NHIS clients was USD 7 (4, 17) compared to a median (IQR) of USD 34 (22, 74) by non-insured clients. The total OOP by males was USD 41,674 compared to USD 19,550 among females. The median (IQR) OOP between gender was relatively similar even though it was higher in males [USD 29 (10, 62)] compared to females [USD 23 (7, 50)]. When the insurance cover of the victims was taken into account, uninsured victims paid more than 4 times as much as those with insurance paid, with very little differences between males and females. From 2016 to 2018, there was a steady increase in the total OOP for snakebite victims at the hospital. However, the total OOP almost tripled, from USD 10,720 in 2018 to USD 29,903 in 2019. In response, the median (IQR) increased by about a factor of 4 from USD 22 (9, 32) in 2018 to USD 97 (22, 119) in 2019. The situation was much more dire for non-insured clients when the median(IQR) increased from USD 27 (18, 38) in 2018 to USD 103 (84, 124) in 2019. The insured clients were not spared the surge, paying a median(IQR) of USD 7 (5, 10) in 2018 to USD 92 (6, 103). It can be noted that the absolute difference in the medians between the insured and uninsured victims

For a successful treatment, victims without insurance cover paid a median(IQR) of USD 34 (22, 72) compared to USD 7 (4, 17) who had insurance cover.

**Table** **:** Summary of OOP experienced by snakebite victims

|  | Total | Median(IQR) | Breakdown | |
| --- | --- | --- | --- | --- |
| **Characteristic** | **N = 1,391**1 | **N = 1,391**2 | **Cash & Carry**, N = 9352 | **NHIS**, N = 4562 |
| Payment mode |  |  |  |  |
| Cash & Carry | 48,949 | 34 (22, 74) |  |  |
| NHIS | 12,274 | 7 (4, 17) |  |  |
| Gender |  |  |  |  |
| Female | 19,550 | 23 (7, 50) | 32 (19, 74) | 7 (4, 17) |
| Male | 41,674 | 29 (10, 62) | 35 (22, 73) | 7 (4, 19) |
| year |  |  |  |  |
| 2016 | 9,919 | 25 (5, 40) | 33 (23, 47) | 4 (2, 6) |
| 2017 | 10,682 | 23 (10, 40) | 34 (23, 49) | 10 (4, 14) |
| 2018 | 10,720 | 22 (9, 32) | 27 (18, 38) | 7 (5, 10) |
| 2019 | 29,903 | 97 (22, 119) | 103 (84, 124) | 92 (6, 103) |
| Season |  |  |  |  |
| Dry | 38,040 | 27 (9, 57) | 34 (22, 74) | 7 (4, 16) |
| Rainy | 23,184 | 27 (9, 65) | 33 (21, 72) | 8 (4, 28) |
| Activity related to farming |  |  |  |  |
| Harvesting | 10,571 | 29 (11, 95) | 35 (21, 106) | 8 (4, 44) |
| Irrigation/hunting | 22,227 | 29 (11, 59) | 36 (24, 75) | 8 (4, 18) |
| Land preparation | 12,503 | 24 (7, 51) | 34 (19, 69) | 6 (3, 13) |
| Farming | 15,922 | 24 (8, 49) | 31 (20, 53) | 7 (3, 17) |
| Outcome |  |  |  |  |
| Died | 1,252 | 62 (18, 87) | 62 (24, 86) | 180 (97, 264) |
| Discharged Alive | 59,972 | 27 (9, 59) | 34 (22, 72) | 7 (4, 17) |
| 1Payment: Sum | | | | |
| 2Payment: Median (IQR) | | | | |

### OOP by services received

The total (%) OOP on accounts of drugs purchases were USD 34,974 (57%) of all OOP with a median (IQR)= USD 4 (1, 19) (Table ). This was followed by the provision of services (e.g., ward admissions, wound dressing, x-rays, labs, etc.) accounting for USD 22,426 (37%), with a median (IQR) = 4 (1, 19). Lastly the total OOP [(%), Median (IQR)] for consultations was USD 4,034 (6.6%), 3 (2, 4) of all OOP.

**Table** **:** OOP by services received

|  | Sum(%) | Median(IQR) |
| --- | --- | --- |
| **Characteristic** | **N = 4,173**1 | **N = 4,173**2 |
| Item |  |  |
| Consultation | 4,034 (6.6%) | 3 (2, 4) |
| Drugs | 34,974 (57%) | 4 (1, 19) |
| Services | 22,426 (37%) | 12 (4, 22) |
| 1Sum (%) | | |
| 2Median (IQR | | |

#### Payments by mode of Insurance status

As indicated earlier, the total OOP at the hospital was USD 61,224. Of the total OOP, USD 48,949 were paid by victims without an insurance cover at the time of admission. The median (IQR) for clients with an insurance cover was USD 33.9 (21.9, 74.2) and 7.2 (3.6, 17.2) those without an insurance (Table ). Victims without a health insurance cover paid a total of USD 3,523.84 for consultation compared to USD 510.35 among victims with the NHIS, bringing it to a total of 4,034.19. The median payment for consultation for victims without insurance cover was USD 3.7 (3.3, 4.1) compared to a median(IQR) of USD 1.2 (0.4, 1.5) among victims with insurance cover. The hospitals exempted an amount of USD 140 for victims with an insurance cover, reasons for which were not stated in the EHR.

**Table** **:** Summary of payments by snakebite victims

|  | Total | | | Summary | |
| --- | --- | --- | --- | --- | --- |
| **Characteristic** | **Cash & Carry**, N = 9351 | **NHIS**, N = 4561 | **Overall**, N = 1,3911 | **Cash & Carry**, N = 9352 | **NHIS**, N = 4562 |
| Payment | 48,949 | 12,274 | 61,224 | 33.9 (21.9, 74.2) | 7.2 (3.6, 17.2) |
| Consultation | 3,523.84 | 510.35 | 4,034.19 | 3.7 (3.3, 4.1) | 1.2 (0.4, 1.5) |
| Drugs | 25,435 | 9,539 | 34,974 | 6.6 (2.6, 26.5) | 2.0 (0.1, 4.5) |
| Other Services | 20,062 | 2,365 | 22,426 | 17.2 (9.8, 26.5) | 3.5 (0.9, 6.8) |
| Exemptions | 70.7754 | 140.3553 | 211.1306 | 0.0 (0.0, 0.0) | 0.0 (0.0, 0.0) |
| 1Sum | | | | | |
| 2Median (IQR) | | | | | |

## Analysis of data

The fitted regression model shows victims with an insurance cover (NHIS) at the time of the bite experienced a statistically significant average of USD -17 (95% CI -28, -5.5; p=0.004) lesser OOP compared to the victims with an insurance cover. Compared to 2016, the average OOP expenditure in 2017 was lower by an average of USD -3.2 (95% CI -11, 4.3; p=0.4). The average OOP further declined in 2018 to USD -10 (95% CI -18, -3.2; p=0.005) but raised sharply to USD 68 (95% CI 60, 75; p<0.001) in 2019. The average differences from 2018 to 2019 were statistically significant. Victims that died spent USD -17 (95% CI -34, 1.2; p=0.068) less compared to those that were discharged alive from the hospital. The average OOP increased by USD 3.9 (95% CI 3.2, 4.6; p<0.001) for each day on admission.

The interaction of the variables, however, showed a different phenomenon. Victims with an insurance cover spent averagely less than those with an insurance cover in 2017, USD-2.6 (95% CI -16, 11; p=0.7). Compared to the same reference year (2016), OOP expenditure by victims on the NHIS increased from USD 1.2 (95% CI -12, 15; p=0.9) in 2018 to USD 12 (95% CI -1.7, 26; p=0.086) in 2019, suggesting the NHIS may have exerted a negative influence of the OOP experienced by victims. However, the differences in the averages were not statistical significant from the OOP in 2016. Lastly, for each day on admission, the average OOP for victims with an insurance cover compared to those that did not was USD -2.8 (95% CI -4.2, -1.5; p<0.001).

**Table** **:** Regression model on predictors of OOP at the hospital

| **Characteristic** | **Beta** | **95% CI**1 | **p-value** |
| --- | --- | --- | --- |
| Payment mode |  |  |  |
| Cash & Carry | — | — |  |
| NHIS | -17 | -28, -5.5 | 0.004 |
| Year |  |  |  |
| 2016 | — | — |  |
| 2017 | -3.2 | -11, 4.3 | 0.4 |
| 2018 | -10 | -18, -3.2 | 0.005 |
| 2019 | 68 | 60, 75 | <0.001 |
| Outcome |  |  |  |
| Died | — | — |  |
| Discharged Alive | -17 | -34, 1.2 | 0.068 |
| Length of stay | 3.9 | 3.2, 4.6 | <0.001 |
| Payment mode \* Year |  |  |  |
| NHIS \* 2017 | -2.6 | -16, 11 | 0.7 |
| NHIS \* 2018 | 1.2 | -12, 15 | 0.9 |
| NHIS \* 2019 | 12 | -1.7, 26 | 0.086 |
| Payment mode \* Length of stay |  |  |  |
| NHIS \* Length of stay | -2.8 | -4.2, -1.5 | <0.001 |
| 1CI = Confidence Interval | | | |

## Discussions

The objective of the study was to describe the OOP experienced by victims of snakebites visiting a rural hospital in Ghana using the records available in the Electronic Health Records (EHR) of the hospital from 2016 to 2019. To the best of our knowledge, this is the first of its kind in Ghana and Sub-Saharan Africa. A total of 1391 records retrieved from the EHR and the total OOP of snakebite victims was USD 61,224. The victims were mostly males and younger.

This study has demonstrated that snakebite victims in rural Ghana experience a significant OOP. The median (IQR) OOP for the victims was USD 27 (9, 60) which is very high given the average monthly income in Ghana was around USD 114.2857143 at the time. Household income in rural areas is certainly lower than the national average. Given that the major economic activity within the communities is farming, the OOP may have pushe some households into catastrophic health expenditure.

The victims without an insurance experiencing the worst median OOP expenditure 26.8 which compares very similarly to OOP in Kenya as reported by22 but harshly with OOP in Sri Lanka according to2. Most of the victims did not have a health insurance cover at the time of the bite and unsurprisingly spent 27 a median more than their colleagues with an insurance. The median difference in OOP between those with insurance and those without was statistically significant (<0.001).

The median cost of care for snakebite victims increased with each year (2016 to 2019). The year of the incidence exhibited a strong linear relationship with OOP p<0.001. However, when the insurance status of the victim was taken into account, the statistical difference was no more (p=0.7) demonstrating that the NHIS fails to protect snakebite victims of OOP. It is the opinion of the authors that the surge in OOP in 2019 was due to the hospital reviewing the cost of their drugs. This further suggests the NHIS has played a little role in alleviating OOP among snakebite victims year-on-year.

The biggest driver of OOP among the victims was drugs, accounting for USD 34,974 (57%) of the total cost. OOP for services (including laboratory services) followed as the second highest cost.

| Item | Estimate | LCI | UCI | pvalue |
| --- | --- | --- | --- | --- |
| Consulting | -2.65 | -7.14 | 1.84 | 🙅️0.544 |
| Drugs | -6.28 | -10.77 | -1.79 | 😀0.001 |
| Services | -16.27 | -20.76 | -11.78 | 😀0.001 |

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