ORIGINAL RESEARCH

Estimating the Burden of Snakebite on Public Hospitals in KwaZulu Natal, South Africa

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Objective.—We propose a formula as a means to estimate the number and incidence of snakebites treated per annum in KwaZulu Natal (KZN), South Africa.

Methods.—Using an unvalidated formula that includes an antivenom ratio, we crudely estimated the total number of snakebite presentations in KZN. Using antivenom supply data from the central pharmacy, we stratified a sample of 6 hospitals that were surveyed to establish an antivenom ratio, that is, the total number of patients receiving antivenom to the total number of snakebite presentations at hospitals. The antivenom ratio and the average number of antivenom vials for treated snakebites were incorporated into a formula to crudely estimate the number of snakebite presentations. This was then applied to all public hospitals and districts in the region.

Results.—Seventy-eight percent of public hospitals were included. The mean antivenom ratio derived from the sample hospitals indicated that 12% (95% CI, 10–14%) of snakebite presentations received antivenom. We estimated an annual total of 1680 (95% CI, 1193–2357) snakebite presentations to hospitals. Two thirds of cases (1109 of 1680) were in the low-lying subtropical coastal region. Few cases were in the higher, cooler regions of KZN (87 of 1680) or the metropolitan city of Durban (93 of 1680). The overall incidence for KZN was 16/100,000. The estimated cost of snakebite in KZN was between $1,156,930 and $2,827,848.

Conclusions.—We propose an alternative method to estimate the annual number of snakebite presentations to hospitals.

Key words: snakebite, antivenom, antivenom ratio, incidence, mortality, South Africa, KwaZulu Natal, distribution, costs

Introduction

Snakebite is an important disease that is difficult to quantify in terms of patient numbers and outcomes. The worldwide data on snakebite are limited, and region-specific data on snakebite numbers in Southern Africa are lacking. These data are critical to understand disease burden and to institute appropriate prevention and treatment strategies. Global information is sourced from various government departments and global organizations such as the World Bank, World Health Organization, and the United Nations. These reports are supported by scattered studies from hospital records and local surveys in communities affected by snakebite.[1] The current published data suggest that the greatest burden rests in Asia (approximately 15,400–57,600 deaths per annum) and sub-Saharan Africa (approximately 3500–32,100 deaths per annum).[2] Estimates put the number of snakebites in sub-Saharan Africa at 100,000 to 500,000 per year.[3] It is striking that the quoted snakebite numbers have a wide range and fall short of providing specific regions with accurate estimates. This is largely because of poor documentation of snakebites by health-care practitioners and health facilities, lack of collation of cases by central health authorities, and healthcare practitioners such as traditional healers who have no formal documentation process.[1,4] Snakebite is not a reportable disease, and as a result there is a noticeable paucity of good data from South Africa. In addition, there are no national standardized snakebite treatment guidelines, resulting in different prescribing habits from clinicians in the hospitals of South Africa.

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One region in South Africa known to have a high number of snakebites is KwaZulu Natal (KZN).[5–7] However, there are no accurate data on patient numbers and snakebite distribution. Various authors have noted that the mix of poverty, tropical climates, and a rural subsistence population creates a hotspot for snakebites.[8–10] KZN has areas that have these 3 ingredients. We aim to use a different approach for estimating the number and incidence of snakebites presenting to public hospitals in KZN by using a formula. By combining antivenom supply figures in the province and extrapolating the data derived from the formula, we hope to quantify the distribution of snakebite presentations and the costs to healthcare in KZN.

Methods

SETTING

Serving the health needs of KZN's 10.8 million people are 11 districts with 72 public hospitals. Public hospitals are nonprivate institutions that are free-access hospitals serving the vast majority of South Africans. The majority of these are local district hospitals, 12 are regional hospitals, and 4 are tertiary referral centers.[11–13] The starting point for estimating snakebite numbers is the KZN Department of Health central pharmacy antivenom supply data, based in Durban. The KZN central pharmacy is the only supplier of antivenom to public hospitals in KZN and keeps accurate records. All public hospitals that require antivenom are supplied according to need without constraints. Using these supply figures for a 2-year period, we identified the hospitals that treated snakebites.

SAMPLE POPULATION

Patients who presented to a public hospital in KZN with snakebite were included in the study. Within this group, all patients who were treated with antivenom were admitted for a period of observation. A stratified sample of 6 hospitals spread across the province were selected on the basis of having treated a reasonable number of snakebites with antivenom (Figure 1). Such a selection was made by including those hospitals that prescribed at least 40 antivenom vials during a 2-year period. We made the assumption that these sites had treated enough snakebites to provide an adequate patient sample size for analysis. Unpublished data from a retrospective analysis of snakebite for 5 years at the sixth hospital (a snakebite referral center) in the northeast of KZN were also included. Patient demographic details were stored on a password-protected Excel (Microsoft Corp, Redmond, WA) spreadsheet and anonymously analyzed using a simple numbering system.

DATA COLLECTION AND MEASUREMENT

We collected data on the number of antivenom vials distributed to hospitals in KZN using supply records from the provincial central pharmacy, which is the sole supplier to public hospitals. In addition, a survey using hospital admission records was conducted at each sample site. Any person bitten by a snake who presented to the hospital was entered into the admissions book. Details on whether the patient was envenomated or not were not captured. Those patients who received antivenom were documented. Because not all snakebites presenting at a given facility require antivenom treatment, we crudely estimated the number of snakebites using a formula created by the authors that has not been validated previously. The formula includes the antivenom ratio, which is the proportion of patients receiving antivenom to the total number of patients presenting with snakebite at each sample facility. The formula was then applied to all hospitals that were not in our sample and extrapolated to each district. The total number of snakebite presentations to public hospitals can be calculated using this formula:

$$TS = (V/a)/R$$

where *TS* is the total snakebite number, *V* is the total antivenom vials used in a year, *a* is the average number of vials per patient receiving antivenom treatment, and *R* is the the ratio or proportion of patients receiving antivenom to the total number of patients with snakebite (antivenom ratio). The term *V/a* equates to the number of patients treated with antivenom.

DATA ANALYSIS

We used the data from the sample hospitals to calculate the weighted average (scaled by caseload) of the pooled effect size for the average number of vials used per patient as well as the antivenom ratio. We also used the 95% CIs from these estimates to obtain worst versus best case projections of snakebites. The formula, derived from the 6 sample hospitals, was applied to all hospitals treating snakebite to estimate the total number and distribution of snakebite presentations in KZN. Population statistics were retrieved from the KZN Provincial Census data, and hospital admission figures were obtained from the KZN provincial District Health Information Systems database.[11–13] Population for 2013 is estimated using a growth rate of 1.018% applied annually. Ethics approval was obtained from the Biomedical Research Ethics Committee of the University of