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SURGERY IN LOW AND MIDDLE INCOME COUNTRIES

The Operative Output of District Hospitals in KwaZulu-Natal Province is Heavily Skewed Toward Obstetrical Care

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Abstract

Introduction District hospitals are key to providing universal coverage of essential surgery and for strengthening surgical care in general. This audit set out to quantify the surgical output of all the district hospitals in KwaZulu-Natal Province (KZN) over a 6-month period to see whether district hospitals were delivering the surgical care they are expected to deliver.

Results There were a total of 18,871 operations performed at 37 district hospitals in KwaZulu-Natal from July to December 2015. The number of operations per hospital varied widely between 2150 at a single large district hospital and 68 at a small district hospital, respectively. Surgical operations for obstetrical conditions made up by far the majority of operations at 57%, with gynecological operations making up the second highest at 15%. Only 12% of operations were for general surgical conditions. With regards to the bellwether procedures, 96.1% of these were cesarean sections, 2.1% were laparotomies and 1.8% were ORIFs. For almost all the 37 hospitals, the percentage of laparotomies and ORIFs performed was small to negligible, while the percentage of cesarean sections performed was high. The number of bellwether operations performed per 100,000 population was much higher than the number of general surgical or orthopedic operations performed, primarily because of the preponderance of cesarean sections conducted in each hospital. We observed a strong and significant positive correlation (+0.691, 95% CI +0.538 to +0.800, $p < 0.001$) between increasing distance to nearest regional referral hospital and rate of laparotomies and ORIF procedures performed.

Conclusions The surgical output of district hospitals in KZN is heavily skewed toward obstetrics and gynecology. Further work is required to understand the reasons for this, but the current data imply that district hospitals are not delivering surgical and orthopedic care at district hospitals in KwaZulu-Natal.

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Introduction

The Lancet Commission on Global Surgery (LCOGS) has highlighted the fact that there is a massive unmet burden of surgical disease in low- and middle-income countries and that this lack of access to safe and effective surgery and anesthesia translates into significant morbidity, expense and mortality [1, 2]. Safe and effective surgical and anesthetic care has been shown to be a cost-effective intervention and, as such, must be considered to be part and parcel of a primary health care-oriented health system. The district health system (DHS) in South Africa is the vehicle for the provision of a package of "comprehensive primary health care services" and has been developed to provide patients with access to appropriate health care close to their homes [3, 4]. The initial point of surgical care is the district hospital, which forms part of the district health system as defined by national policies. These institutions are staffed by non-specialist doctors who have a broad range of clinical skills and competencies. It is expected that these institutions should have the capacity to deliver safe and effective surgical care. However, the scope of this surgical care remains poorly defined. The Department of Health states the surgical services offered at district hospital levels should include: minor surgical operations including biopsies, circumcision, incision and drainage, debridement, aspiration, as well as major surgical operations which include appendectomy, laparotomy, amputations, skin grafts, hernia repair and hydrocelectomy, as well as operations for trauma and emergency general surgical conditions [3–5]. This is very much in keeping with what the World Health Organization (WHO) advocates in the text "Surgical Care at the District Hospital" [5]. Collecting data on the availability and performance of so many diverse operations is difficult, and the lack of a suitable metric makes it difficult to benchmark and quantify surgical services. In response to this need to create a simple-to-collect and easy-to-use metric, researchers have suggested that a number of so-called bellwether operations can be used as proxy measurements to quantify access to surgical care. These bellwether operations are laparotomy, open reduction of a fracture (ORIF) and cesarean section (CS) [6, 7]. In principle, an appropriate surgical system should ensure that every patient in a geographical area has access within 2 h to an institution capable of delivering all three bellwether procedures [6–8]. This audit set out to quantify the surgical output of all the district hospitals in KwaZulu-Natal Province (KZN) over a 6-month period to see whether district hospitals were delivering the surgical care they are expected to deliver. A secondary aim was to quantify access around the province to the bellwether procedures.

Clinical setting

KwaZulu-Natal Province is situated on the eastern seaboard of South Africa and has an area of 94,361 km^2 and a population of just over 10 million people. It has a densely inhabited coastal area around the port city of Durban as well as a number of other urban conurbations namely Pietermaritzburg, in the midlands, the Ladysmith/Newcastle area in the north west and a large port at Richards Bay, 2 h north of Durban. However, about half of the population is rural and experiences high levels of deprivation and poverty. Hospital services are provided by district (level 1) hospitals which are located throughout the province and by regional (level 2) and tertiary (level 3) hospitals which are located in the urban centers. There is one quaternary (central) hospital located in Durban. Figure 1 shows the KZN Province's major centers, the borders of the health districts and the population density.

Method

This study describes the operations conducted at all district hospitals in the public sector of KwaZulu-Natal Province for the period of July 1 to December 31, 2015. Data were collected from operation theater registers for the last 6 months of 2015 from all district hospitals in KwaZulu-Natal. The variables collected included: the district in which the hospital is placed, the name of the operation, the date of the operation and the outcome of operation, if available. The data were entered into an Excel database by staff in the epidemiology unit and checked and cleaned by the principal investigator. The percentage of each bellwether operation conducted at each facility was calculated. In addition, the data were coded depending on the type of operation into obstetrics, gynecology, general surgery and orthopedics. The percentage of different categories of operations was then calculated from the total number of operations conducted in each hospital. Further, the number of bellwether and general surgical operations per 100,000 catchment population was calculated for each hospital. This was worked out for the 6-month period of data review.

Analyses were performed using Stata software version 13 [StataCorp. 2013. Stata Statistical Software: Release 13. College Station, TX: StataCorp LP]. Spatial risk surfaces for onset for surgical rates per 100,000 were developed using a Bayesian geostatistical (point process) model and integrated nested Laplace approximation (INLA) using R 3.4.3 and visualized using ArcGIS 10.2, and a figure depicting access to surgical care across the province was constructed using GPS software. Finally, the relationship between distance to a regional referral hospital and the

number and type of operations conducted was investigated assessed using the Spearman rank correlation coefficients.

The study was approved by the Biomedical Research Committee of the University of KwaZulu-Natal (reference: BE528/16) and by the KZN Department of Health (reference: KZ_2016RP21_975).

Results

There were a total of 18,871 operations performed at 37 district hospitals in KwaZulu-Natal from July to December 2015. The number of operations per hospital varied widely between 2150 at a large district hospital and 68 at a small district hospital, respectively. Surgical operations for obstetrical conditions made up by far the majority of operations at 57%, with gynecological conditions making up the second highest at 15% (Fig. 2). Only 12% of operations were for general surgical conditions. With regards to the bellwether procedures, 96.1% of these were cesarean sections, 2.1% were laparotomies and 1.8% were ORIFs. There was a strong correlation between the percentage of cesarean sections conducted and the percentage of all obstetrical and gynecological operations done (Spearman correlation coefficient = +0.87, $p < 0.01$), as well as between the percentage of laparotomies conducted and the percentage of all general surgical operations (Spearman correlation coefficient = +0.46, $p < 0.01$) and the percentage of ORIFs conducted and the percentage of all orthopedic operations performed (Spearman correlation coefficient = +0.72, $p < 0.01$). Table 1 lists all the district hospitals and indicates which of them have the capacity to perform each of the three bellwether procedures. It goes on to break down the total operative output for each district hospital in terms of all obstetrical/gynecological, general surgical and orthopedic operations performed. Several of the 37 hospitals had performed no laparotomies during the period of the study, and even more had not performed an ORIF. In general, the percentage of surgical and orthopedic operations performed was low to negligible, while the percentage of obstetrical and gynecological operations performed was high.

There was a strong and highly significant correlation between the number of bellwether procedures per 100,000 population and the distance of the district hospital from its regional referral hospital (Spearman rank correlation coefficient = +0.51, $p < 0.001$). There was a weaker correlation between the rate of cesarean section alone and the distance of the district hospital from its regional institution (Spearman rank correlation = + 0.442 on 65 observations (95% CI 0.222 to 0.619)), compared to the rate of laparotomies plus ORIFs versus distance between the district and regional hospital (correlation = +0.691 on 65 observations (95% CI 0.538 to 0.800)). Figures 3 and 4 are heat figures showing the output of general surgical procedures and obstetrical/gynecological procedures across the province.

Discussion

Approximately 16% of the global burden of disease is surgical, and the delivery of safe and effective surgery and anesthesia has been shown to be a cost-effective intervention [1–4]. The primary health care approach is intended to empower local communities by bringing health care to them, rather than centralizing it at the large academic urban facilities. This is in keeping with the World Health Organization's support of surgical care at the district hospital level, and the scope of services defined for district hospitals in South Africa [3] is very much in keeping with the package of services which the WHO suggests should be offered at this level [5].

A number of metrics have been proposed to measure and benchmark the capacity of a surgical service. These include the percent of population with access within 2 h to a facility capable of safe emergency surgery, the proportion of emergency surgical procedures performed within 24 h, the number of trained providers per population, the procedure rate per population, the elective-to-emergency procedure ratio and the percent of district-level hospitals which satisfy the requirements for safe surgery [6–8]. The outcome of emergency surgical conditions is both time and access dependent. Increasing delays to definitive care translates into increased morbidity, expense and mortality.

The concept of a bellwether operation was proposed to simplify the use of these metrics by focusing on three common generic emergency operations which are proxy markers for the adequacy of surgical cover for a population [6–8]. The three bellwether operations should be readily available within 2 h to the entire population, if a surgical service is to be considered adequate. Our data suggest that the district hospitals in KZN are not delivering the spectrum of services they are expected to provide as two of the three bellwether procedures, namely laparotomy and ORIF, collectively constitute only 4% of the total bellwether procedures performed in the province. The low rate of the two non-obstetrical bellwether operations seems to translate to a more global deficit in general surgical and orthopedic procedures, which as a whole comprise only 18% of the total surgical output of the district hospitals in KZN.

There is a realization in South Africa that access to surgical care needs to be expanded dramatically and there have been a number of initiatives and proposals intended to further this agenda [4, 9]. The idea of a competent "district" or "rural" surgeon who would have basic surgical,

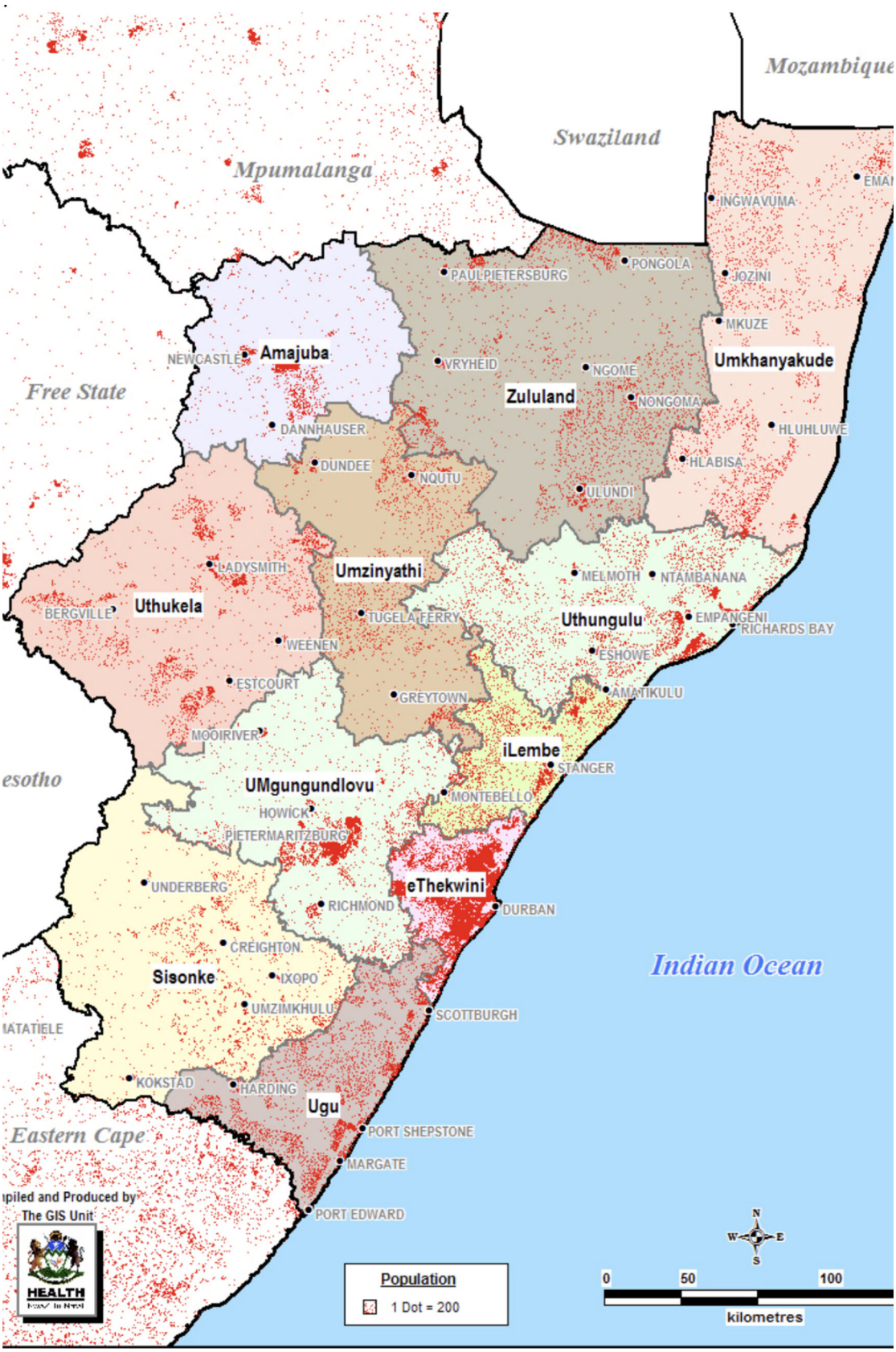

Fig. 1 Major urban centers, population density and health care districts in KZN

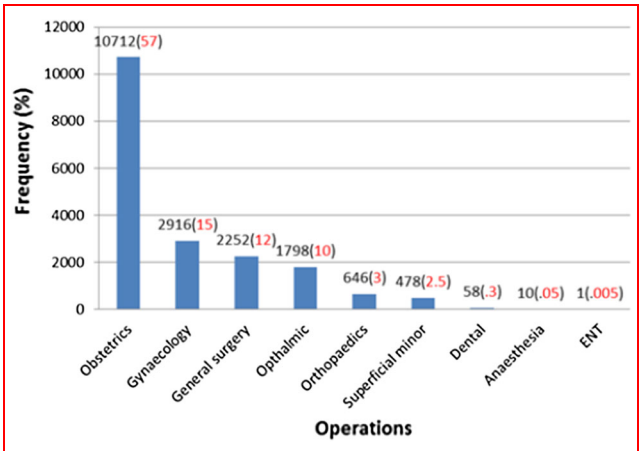

Fig. 2 Types of operations performed in district hospitals in KZN from July to December 2015. The Y-axis refers to the frequency each operation was performed out of the total of the total of 18,871 operations performed at district hospitals over the time period under review

anesthetic and obstetrical competencies and would be able to deliver all the bellwether procedures is one such proposal. Some authors have suggested that the ability to perform a cesarean section predicts the ability to perform all other general surgery and anesthesia procedures [6]. The anesthetic and surgical skill sets required to safely perform a CS are similar to those required for a laparotomy and ORIF. However, this does not appear to be the case in our environment and the reasons for this are unclear [4, 9]. Cesarean sections make up 56% of all surgical procedures performed in the district hospitals of KZN, and gynecological procedures a further 15%, by far out numbering all general surgical and orthopedic procedures. It does not appear that being able to perform cesarean sections and basic gynecological procedures translates into the capacity or the willingness to perform the other bellwether operations. This calls into question some of the assumptions underpinning the bellwether concept [6–8].

The geographical distribution of operative activity in KZN shows that those hospitals remote from access to a regional institution develop general surgical skills, but that those closer to their referral centers tend to refer general and other surgical procedures to these higher-level institutions. However, the same does not hold true for obstetrics and gynecology and there is a less strong correlation between remoteness of the district institution from a referral center and the ability to perform obstetrical and gynecological surgery. This widespread capacity to provide obstetrical and gynecological care may be due at least in part to the emphasis at policy level on maternal and women's health, and to the establishment of the National Committee for Confidential Enquiries into Maternal Deaths which reviews maternal deaths across the country [10]. A similar focus on the provision of other types of surgical care has been lacking, and this may well contribute to the poorer outcomes for common surgical diseases experienced by rural patients in KZN [11].

Table 1 Capability to perform a bellwether procedure and the comparison of the total percentage of procedures per clinical discipline per district hospital

Hospital number	C/S	Laparotomy	ORIF	Obstetric/gynecology	General surgery	Orthopedic surgery
1	√	√	0	73	25	2
2	√	√	0	82	13	4
3	√	0	0	94	6	0
4	√	√	0	99	1	0
5	√	√	0	98	2	0
6	√	0	0	100	0	0
7	√	√	0	99	1	0
8	√	√	0	43	1	0
9	√	√	√	82	13	2
10	√	0	0	96	4	0
11	√	√	0	83	12	0
12	√	√	√	82	7	11
13	√	√	0	69	21	1
14	√	√	√	79	9	3
15	√	√	0	99	0	0
16	√	√	0	83	5	1
17	√	√	√	96	3	1
18	√	0	0	100	0	0
19	√	√	√	38	54	3
20	√	0	0	97	2	1
22	√	√	0	98	1	0
23	√	√	0	47	16	3
24	√	√	√	60	33	6
25	√	√	√	43	2	3
26	√	0	0	72	27	1
27	√	√	√	82	14	3
28	√	√	√	78	19	1
29	√	√	√	51	20	15
30	√	√	0	97	2	0
31	√	√	0	86	9	0
32	√	√	0	79	4	0
33	√	0	0	96	1	0
35	√	0	0	97	1	0
36	√	0	0	100	0	0
37	√	√	0	99	1	0

A tick indicates that the hospital can do a particular bellwether operation and 0 that it cannot. If an operation was not performed at all in the 6-month period, we have assumed that the institution concerned cannot perform that particular procedure

The percentages per institution may not equal 100% as there are institutions which perform other operations such as ophthalmology or urology

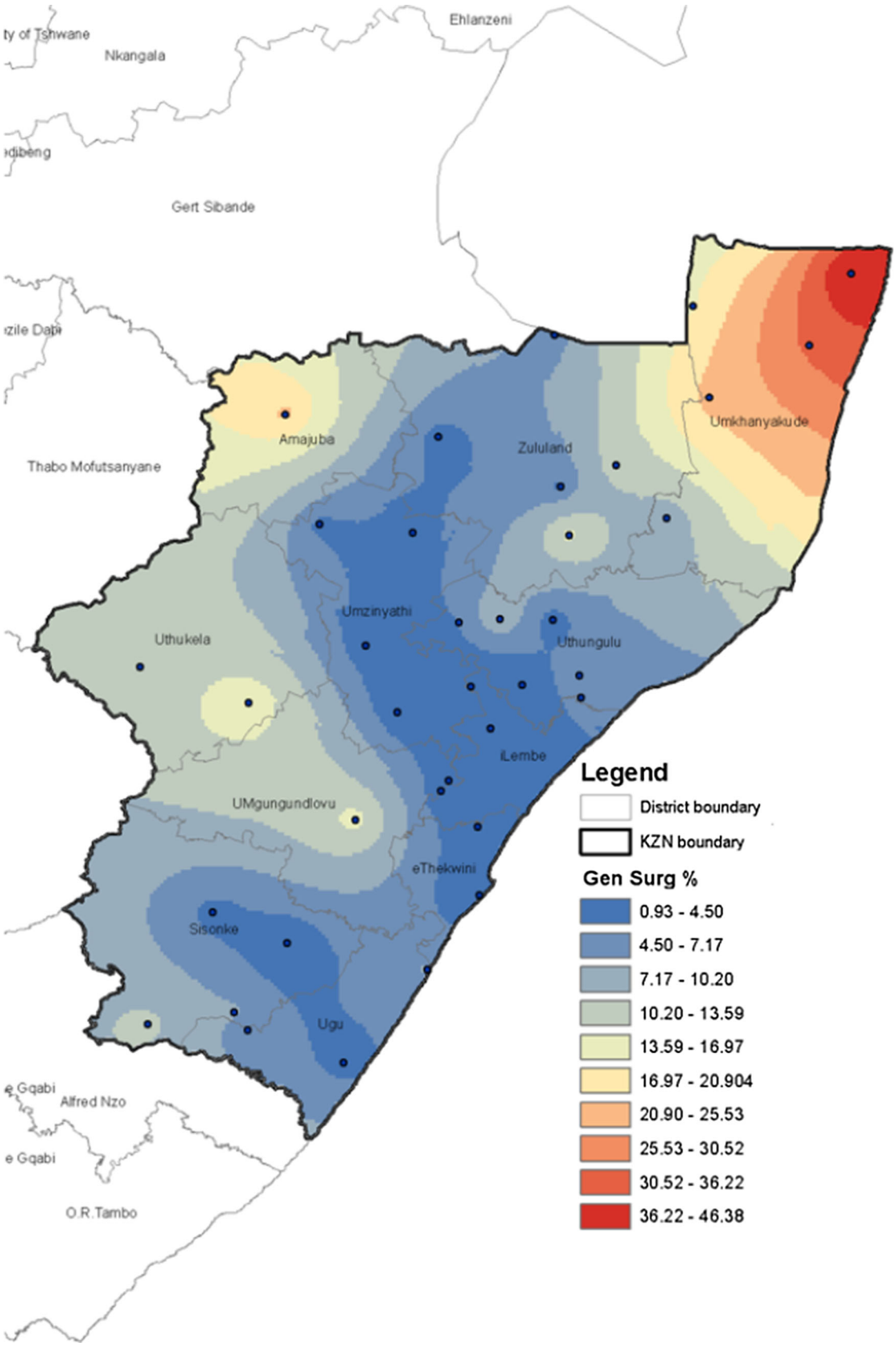

Fig. 3 Relative overall general surgical output of the district hospitals in KZN. Each dot represents a district hospital

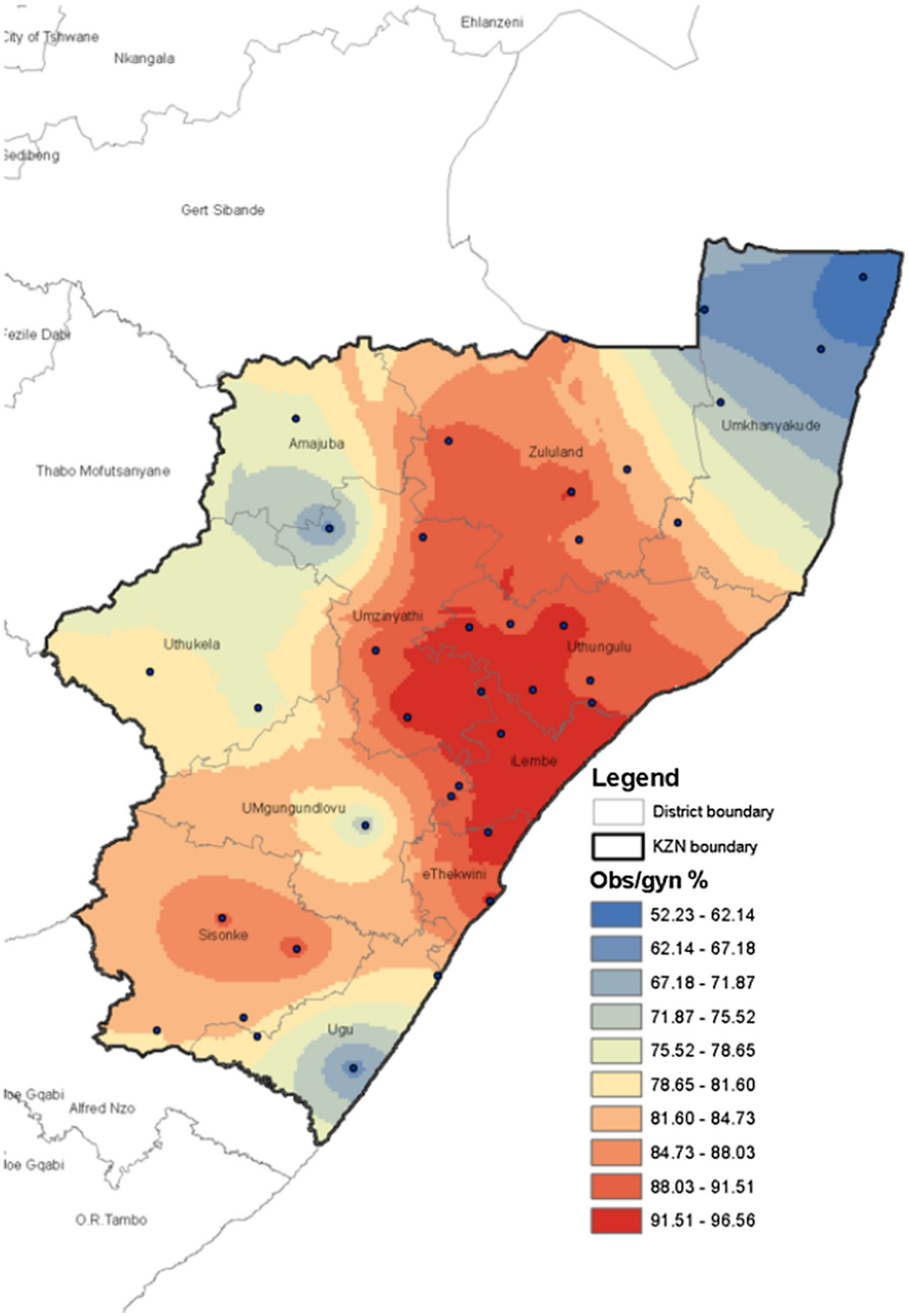

Fig. 4 Relative overall obstetrical output of the district hospitals in KZN. Each dot represents a district hospital

Conclusions

The surgical output of district hospitals in KZN is heavily skewed toward obstetrics and gynecology. The number of non-obstetrical bellwether operations being performed is well below what should be expected based on known population densities and disease profiles. Further work is required to understand the reasons for this, but the current data imply that district hospitals are not providing adequate access to safe and effective surgical and anesthetic care at the primary care level in KwaZulu-Natal.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

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