








# Assessment of Surgical Care Capacity at Non-Tertiary Hospitals in Botswana

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## Abstract

**Background:** Most low- and middle-income communities (LMICs) live in rural areas and are served mainly by primary and district hospitals. This study seeks to geographically map these hospitals and measure their surgical care capacity in Botswana.

**Methods:** This 3-month cross-sectional observational study was conducted at the Department of Surgery, University of Botswana. Google Map was used to map hospitals geographically. The PIPES (personnel, infrastructure, procedures, equipment, and supplies) tool was used to assess the surgical care capacity of hospitals. This tool was developed by Surgeons Overseas to quantify surgical capacity in low-resource settings. Consent was obtained.

**Results:** Nine districts and ten primary hospitals were assessed. The distance from settlements to the nearest healthcare facility in sparsely populated areas was relatively larger, making timely healthcare access potentially problematic. Intensive care services were

unavailable except at three hospitals. None of the hospitals had full blood bank services. X-ray and ultrasound machines and basic supplies were available at over 90% of the hospitals.

**Conclusion:** There was a general lack of surgical care specialists. Hospitals with a full complement of surgical care specialists had relatively higher PIPES indices. We recommend investing in deploying specialized surgical care providers to primary and district hospitals.

**Keywords:** Surgical care capacity; Non-tertiary hospital; Surgical services

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## Introduction

The vision of the Lancet Commission on Global Surgery is universal access to safe and affordable surgical and anesthesia care when needed (1). Good health systems are rooted in the communities they serve (2). This removes the common hurdles that exclude the poor and

marginalized from the needed surgical care, especially those living in rural areas (1). Most communities in low- and middle-income countries (LMICs) live in rural areas (3). District hospitals, also often referred to as regional hospitals, are vital to surgical care delivery to the local

communities in LMICs (4). However, many of these district hospitals are unable to deliver essential surgical services (4, 5). Strengthening the surgical care capacity of these hospitals would improve the delivery of essential surgical services to communities in rural areas (4). LMICs need to carry out local situational assessments to guide their efforts toward improving the delivery of essential surgical care by district hospitals, which serve most rural communities.

National surgical health policies must be driven by local and context-specific data generated through local research (6). Therefore, the continuous assessment of barriers to delivering essential surgical care services at district hospitals is paramount. Findings from such assessments will provide feedback to policymakers and direct their efforts (6). This is especially relevant in LMICs, like Botswana, which is most hit by the failure to deliver timely and readily accessible surgical care to their communities.

Botswana is a high middle-income country with a population estimated at 2 million. Gaborone is the capital city of the country. There are three levels of hospitals in Botswana: referral (tertiary), district, and primary hospitals, in the order of their capacity to deliver healthcare services. The Ministry of Health for Botswana provides the following definitions of levels of hospitals. Primary hospitals are general hospitals that are equipped to deal with most diseases, injuries, and immediate threats to health. District hospitals are major district health facilities equipped with a larger number of beds capable of dealing with intensive and long-term care. Finally, referral hospitals and health facilities are equipped to deal with specialized diseases, medical needs, and care (7).

Most of the primary hospitals were built with the capacity to be upgraded to the district hospital level structurally. This study seeks to provide a geographic map of most primary- and district-level hospitals in Botswana and assess their surgical care capacity. The geographic mapping of these hospitals aims to give a quick visual appreciation of their distribution countrywide. The distance to a healthcare facility in a community is a critical factor in surgical care that is accessible when and where it is needed (8). The

assumption is that the findings will be relevant to other LMICs and add to the growing but limited body of literature on the subject (9).

## Materials and Methods

This is a cross-sectional, observational study conducted over 3 months at the department of surgery, University of Botswana.

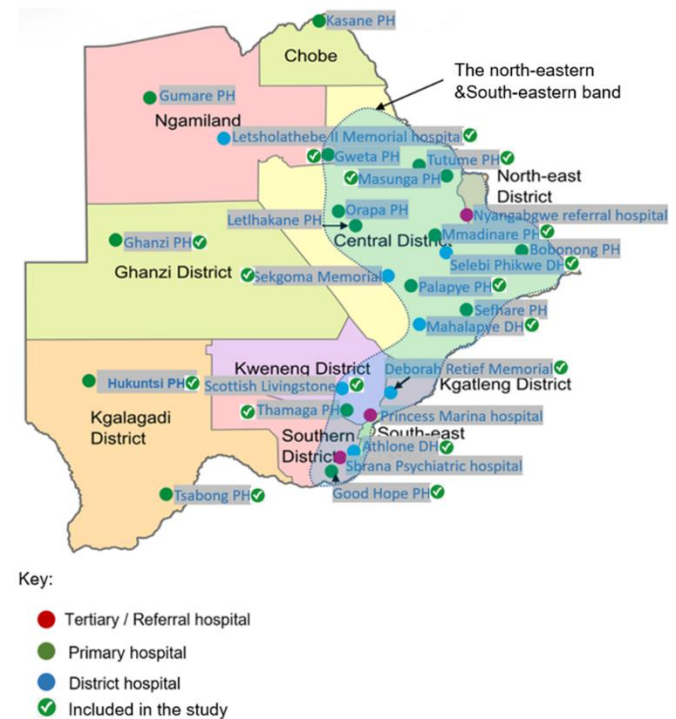


Figure 1. Distribution of hospitals within the ten districts in Botswana.

Botswana is geographically divided into ten districts, as demonstrated in Figure 1. The country's north- and south-eastern band is relatively populous and more developed. The distribution of hospitals is geographically skewed toward this geographic band. Figure 1 shows the geographic distribution of hospitals in Botswana. There are three fully operational tertiary hospitals which are also located along the above-mentioned geographic band. District hospitals comprise seven public, two missionary, and two mining hospitals. There are 17 primary hospitals which can structurally function at the level of a district hospital. The north- and south-western band and the central parts of the country are primarily served by four primary hospitals: Tsabong,

Hukuntsi, Ghanzi, and Gumare and a single district hospital, Letsholathebe Memorial Hospital, northerly. The government also provides ambulance services at each hospital for free transport of patients to tertiary hospitals, should the need arise.

	Letsholathebe ii memorial hospital	Hukuntsi primary hospital	Tsabong primary hospital	Scottish livingstone hospital (D)	Thamaga primary hospital	Deborah relief memorial hospital (D)	Selibe phikwe district hospital (D)	Palapye primary hospital	Sekgoma memorial hospital (D)	Mahalapye district hospital (D)	Good hope primary hospital	Kanye seventh-day Adventist	Bamalete lutheran hospital (D)	Athlone district hospital (D)	Masunga primary hospital	Gweta primary hospital	Tutume primary hospital	Mmadinare primary hospital	Ghanzi primary hospital
Hospital beds (total numbers)	270	32	32	349	37	132			350	275	30	67	142	174	50	50	44	55	96
Personnel																			
Total P-score	7	6	12	7	7	10	8	7	10	9	5	9	17	12	5	5	8	6	10
Infrastructure (13)																			
Total I-score	14	10	10	11	11	11	11	10	13	15	6	12	13	11	10	10	9	7	13
Procedures																			
Total Pr-score	16	16	16	16	14	16	16	16	16	16	9	16	16	16	16	16	16	7	16
Equipment																			
Total E-score	21	19	21	21	21	21	21	20	21	21	14	21	21	21	20	21	21	15	21
Supplies																			
Total S-score	23	23	23	23	23	23	23	23	23	23	21	23	24	23	23	23	23	20	23
Sum total	81	74	82	78	76	81	79	76	83	84	55	81	91	83	74	75	77	55	83
PIPES Index	8.29	7.05	7.81	8.38	7.24	7.71	7.52	7.24	8.67	8.00	5.24	8.57	10.19	7.90	7.05	7.14	7.33	5.24	7.90

Table 1. The PIPES Tool table

A total PIPES score is calculated by summing the number of the personnel, infrastructure and number of operating rooms, procedure, equipment, and supplies scores. This number is then divided by the total number of data items (105) and multiplied by 10 to create the PIPES index. There is no maximum number for the PIPES index.

P-score: no maximum

I-score: maximum 13 plus numbers of functioning operating rooms

Pr-score: maximum of 40

E-score: maximum of 22

S-score: maximum of 25

(D), district hospital; P, personnel; I, infrastructure; Pr, procedure; E, equipment; S, structure; IV, intravenous.

A list of hospitals with their toll-free numbers was obtained from the Ministry of Health website (10). The list has 23 district and primary hospitals. Google Map was used to map the geographic location of the hospitals. A telephonic review of surgical care capacity using a PIPES (personnel, infrastructure, procedures, equipment, and supplies) tool questionnaire was conducted for as many hospitals as possible. A purposive sampling method was used. The PIPES tool and index were used to assess the capacity of surgical care at each hospital. The PIPES tool was developed by Surgeons Overseas (SOS) in response to the need for simple, rapid means of quantifying surgical capacity in low-resource settings (11). A PIPES index was calculated from the PIPES variables. The PIPES tool and its index are based on personnel, infrastructure, procedures, equipment, and supplies. Telephonic consent was sought after the objective and relevance of the study was introduced to the participant. Ethical approval was granted by the Ministry of Health, Botswana. The information was corroborated with up to three interviewees. One person from the hospital management, surgeon or anesthetist, and theater matrons or nurses, representing the theater team and management. The PIPES tool is available on the SOS website, [www.surgeonsoverseas.org](http://www.surgeonsoverseas.org).

## Results

Nine district hospitals and ten primary hospitals responded and were available for an assessment. Table 1 shows the PIPES tool results, including the total number of hospital beds ( $M = 128.53$ ;  $SD = 113.973$ ). Intensive care services were largely unavailable except at three hospitals. Seventeen hospitals had blood storage resources, but not full blood bank services. Functional endoscopic services (gastro, colon, and bronchoscopy) were unavailable at all of the hospitals. Basic radiological services (X-ray and ultrasound) and basic supplies were available at all of the 19 hospitals. Tracheostomies and laparoscopic supplies were notably unavailable.

At the time of this study, only three hospitals had surgeons, and only two had anesthetists. Surgical services were largely manned by medical officers and

nurse anesthetists. Seventeen out of 19 of these hospitals had the capacity to give spinal, ketamine and general anesthesia for minor surgical procedures. At least 16 out of 19 hospitals performed Cesarean section, dilatation and curettage, and tubal ligation, as shown in Table 1.

As previously mentioned, the country's north- and south-western band, which is sparsely populated, is largely served by four primary hospitals: Gantsi, Hukuntsi, Gumare, and Tsabong primary hospitals. Tsabong and Gantsi are notable for their relatively higher PIPES index (Figure 1) compared with other primary hospitals, and are comparable to secondary-level hospitals. The two are also among primary hospitals with a higher number of medical officers (8 and 10). The hospital with the highest PIPES index (Figure 1) is a missionary hospital, Bamalete Lutheran Hospital, which is notable for being the only hospital with a general surgeon and an anesthetist. This contrasts with another missionary hospital which has a surgeon but no anesthetist, holding position 9.

## Discussion

This study set out to geographically map the distribution of hospitals in Botswana and assess the surgical capacity of primary and district hospitals using the PIPES tool. The geographical distribution of hospitals was skewed toward the north- and south-eastern band of the country, which stretches along some of the first roads in the country and therefore probably benefited from accessibility to resources. Ensuring equitable access to healthcare regardless of geographic location is an important component of universal health coverage (UHC). Therefore, it is key to reduce the distance or travel time to facilities to ensure easily accessible healthcare (8). The observed geographically disproportional distribution of primary and district hospitals highlights a potential risk to inaccessibility of healthcare services, including surgery. Spatial accessibility is a concern. Poor access to healthcare services has been identified as a challenge in LMICs, resulting in a high mortality rate due to treatable diseases. This is especially the case for vulnerable populations (12–14). This was also highlighted in a recent study conducted in Uganda (8).

The hospital with a distinctively highest PIPES index was notably different from other hospitals by having a general surgeon and an anesthetist. Most of the hospitals were manned by nurse anesthetists and medical officers. In 2015, surgical and anesthesia care was a UHC component leading to the adoption of National Surgical, Obstetrics and Anesthesia Plans (NSOAPS) as long-term strategic plans by LMICs. These were embedded within the governments' broader plans to implement UHC. The shortage of surgery, obstetrics, and anesthesia providers is a major barrier to meeting surgical care needs in LMICs (15). A study assessing capacity for surgery in 17 hospitals in Ghana and other similar studies found the shortage of adequately trained surgical personnel as the greatest barrier to improving surgical care at district hospitals (9, 16, 17). This study also identified this barrier. Few district and primary hospitals in Botswana have a general surgeon and an anesthetist. This limits surgical care services that are regionally available to the local communities without traveling long distances to have those services.

Botswana recently started its first general surgery and anesthesia training programs. This provides a window of opportunity to address the shortage of specialized surgical care providers. The government should invest in training its surgeons and facilitate the rotation of trainees at district and primary hospitals to expand surgical care delivery. Diagnostic endoscopic procedures, which are currently almost nonexistent at district hospitals, may be introduced under appropriate supervision and support of senior surgical trainees. Integrating community surgical services within training programs has the potential to grow the program and expand its reach. Tanzania implemented a similar approach, the "Treat & Train" approach, to provide specialist care to under-served rural populations. This approach also has the potential to create a positive effect on the recruitment and retention of healthcare workers in rural areas (18).

The finding that large and sparsely populated geographic areas are served by fewer primary and district hospitals is a potential barrier to timely and accessible surgical care. However, it was notable that some of these hospitals were relatively more resourced,

especially human resource-wise. The Gantsi Primary Hospital was among the few hospitals with intensive care unit services. The Gantsi and Tsabong Primary Hospitals were among the hospitals with the highest number of medical officers. A similar resource allocation will be desirable for the Hukuntsi Primary Hospital to improve healthcare access to the region. There is a need to build more hospitals in the region to cut down on the distance traveled to access essential healthcare services.

While full blood bank services were largely unavailable, blood storage services were available. Botswana still faces challenges with blood supply after declining to below ten units per 1000 population per year minimum target for adequacy stipulated by WHO (19). As a result, the blood supply to district hospital storage services is still a challenge. However, a study conducted in 2014 showed a higher willingness to donate blood (20). This provides an opportunity for community mobilization initiatives toward improving blood reserves in the country.

The authors acknowledge the limitations of telephonic interviews versus face-to-face interviews in this study. Inability to use visuals to describe scale items during telephonic interviews may lead individuals to respond differently over the telephone than they would in person, as a result of either anonymity provided by the separation between interviewer and subject, amplifying or minimizing the subject's desire to express themselves in a socially desirable manner. Challenges in forming trust caused by the separation between interviewer and subject may also affect response (21). Researchers have also argued that anonymity reduces inhibitions and increases the confidence that responses will remain private, especially when providing less socially desirable information (22, 23). We considered telephonic interviews to be ideal because they were cost-effective and time-efficient, primarily to cover the whole country.

We tried to balance the tradeoff between the benefits and disadvantages of using telephonic interviews. We used a structured (quantitative) and less conversational (qualitative) format to gather structured data aimed at theory testing rather than theory building (21).



Information collected using close-ended rather than open-ended questions tends to be equally robust concerning breadth and depth (21, 24). Three people from each cadre of theater personnel were interviewed to corroborate the data collected. The suitability of the interview times, anonymity of participants, free and voluntary participation, and the significance of the study were clearly communicated during the introduction to address factors that may affect the willingness of individuals to provide information (21).

### Conclusion

Hospitals with a full complement of surgical care specialists had relatively higher PIPES indices, reflective of the better capacity of surgical care delivery. Sparsely populated wide geographic locations had fewer health facilities, potentially making timely access to healthcare services problematic. The lack of specialized healthcare providers is a major concern. We recommend investing in deploying specialized surgical care providers to primary and district hospitals. This would increase surgical care capacity locally, especially at hospitals serving sparsely populated and geographically larger areas.

### Conflict of interest

None to disclose

### Author contributions

M.J.M. conceived the original idea, developed the theory and performed the computations, verified the analytical methods, and supervised the findings of this work. N.C and K.D. developed the theory and participated in the manuscript writing with support from U.C., K.N., M.S., and T.L. All authors discussed the results and contributed to the final manuscript and to the interpretation of the results.

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