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Hepato-pancreato-biliary surgical capacity in East and South African countries: a regional assessment survey

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Abstract

Backgrounds Hepato-pancreato-biliary (HPB) services are not widely recognized in African countries. This survey seeks to assess the current status of HPB surgery in East and Southern Africa.

Methods The Surgeons Overseas Personnel, Infrastructure, Procedure, Equipment, and Supplies (PIPES) survey assessed HPB capacity in East and South African countries. The PIPES score was calculated for hospitals; a higher score indicates greater capacity.

Results Twenty-five responses from 10 countries completed the survey, yielding a median score of 41 (range 18–57). 80% of hospitals are government-operated. Functioning X-ray machines and pre-tested blood banks are the most commonly available resources in 23 (92%) and 20 (80%) hospitals. The most common procedure is open cholecystectomy, performed in 24 (96%) hospitals, while laparoscopic cholecystectomy, distal pancreatectomy, and non-anatomic hepatic resections were conducted in 22 (92%) hospitals. The Whipple operation and liver resection were carried out in 20 (80%) hospitals. Interventional radiology is available in 5 (20%) centers, and liver transplantation was noted in 3 (12%) hospitals. Electrosurgery is available in 25 hospitals, and energy devices are accessible in 19.

Conclusion This study highlights the HPB surgery services in East and Southern African countries. Despite limited resources, certain HPB services are accessible.

Keywords Hepato-pancreato-biliary surgery, Sub-Saharan Africa; surgical capacity, East Africa, South Africa

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Backgrounds

Africa spans 30,300,000 square kilometers, approximately one-fifth of the global land area, making it the second-largest continent [1]. It is sparsely populated, with around 1.53 billion people, which represents about 18.3% of the world's population [2]. Most of Africa's population resides south of the Sahara Desert, where the majority of the inhabitants are Black. In contrast, North Africa is predominantly Mediterranean in terms of climate, customs, and cultural context, rather than being purely African [1]. Geographically, Sub-Saharan Africa encompasses four regions: Central, West, East, and Southern Africa [3].

Only six countries in Sub-Saharan Africa have established national IHPBA chapters, including the Southern African chapter comprising South Africa, Namibia, Zimbabwe, and Botswana, along with those in Kenya and Nigeria [4]. The Lancet Commission defined global surgery as "universal access to safe, affordable surgical and anesthesia care when needed" [5]. In contrast, 93% of the Sub-Saharan African population faces inadequate access to safe and affordable surgical services [5]. HPB surgery includes a variety of procedures for the pancreas, liver, and biliary tree, ranging from simple to complex. Cholecystectomy is considered a straightforward HPB procedure performed by both general and specialized HPB surgeons. Conversely, a Whipple's operation (pancreaticoduodenectomy with reconstructions) necessitates specialized centers.

The development and delivery of HPB service are influenced by many factors, including trained personnel (HPB surgeons, intensivists, radiologists, oncologists, and anesthetists), adequate infrastructure (an intensive care unit, a blood bank, and oncology treatment setup and radiology equipment), and availability of essential equipment [6, 7].

In Sub-Saharan Africa, where nearly all countries belong to low and middle-income countries, these challenges remain the main hindrance to delivering safe and effective HPB services [6]. The poor setup and limited human resources have a direct impact on patient management and limit the extent of HPB surgery across the region.

Assessment of the current situation of the HPB service delivery and critical analysis of the need is a crucial step in improving the HPB services in East and Southern Africa. According to our knowledge, this is the first study to investigate the current HPB services provided in these countries.

Methodology

Study design: This is a cross-sectional survey study conducted from the 3rd of December 2024 to the 25th of December 2024.

Study tool: An online survey was sent to HPB surgeons and general surgeons working in different East and Southern African countries. Any HPB surgeon or general surgeon doing HPB who agreed to participate was included in this study.

The HPB PIPES survey was modified from the questionnaire used by Alatise et al. [8] These are very minor modifications. The HPB PIPES survey was divided into four sub-scales or (Domains). The first scale concerns the personnel providing HPB services, while the other three sub-scales determine the infrastructure, procedure, and equipment.

Data analysis: The HPB PIPES score consists of 58 questions. Consequently, the maximum expected score is 58, as presented in Table 1. Personnel providing HPB services are evaluated in the first subscale. Responses from any number of available personnel will count as one. The maximum score on the personnel scale is 9. Available infrastructure has a maximum score of 11. Each performed procedure counts as one. The total number of evaluated procedures is 25. The equipment and supplies will be presented by 13. The total score will be calculated for each center. Subsequently, the mean, median, maximum score, and standard deviation (SD) will be determined for all the countries.

Results

Participant's character

Twenty-five surgeons working in 10 African countries responded and participated in the survey, with a response rate of 58% (25/43). These countries are Sudan, Ethiopia, Somalia, Uganda, and Kenya, from East and Middle Africa, South Africa, Zimbabwe, Malawi, Zambia, and Botswana, from Southern Africa. 80% of Hospitals are governmental. The number of beds ranges from 60 to 3500. Detailed characteristics of countries and centers participating in the study are shown in Table 2; Fig. 1.

HPB PIPES score

The PIPES score varies across centers and countries. The median score is 41 (out of 58), ranging from 18 to 56. The highest three PIPES scores were recorded in South African cities: Cape Town, Johannesburg, and Pretoria. The lowest PIPES scores were observed in Shendi (Sudan), Kajiado (Kenya), and Blantyre (Malawi).

Personnel Twenty-one surgeons (84%) who participated in this survey were specialized HPB surgeons, while four general surgeons performed HPB surgery. Responses of participants' scores ranged from 4 to 9 out of 11, with a median response of 6. All centers had anesthetists, and 23 (92%) had gastroenterologists.

Table 1 Participant responses to HPB PIPES criteria [*N* = 25]

Personnel		**Available**	**PECENTAGE**
1	HPB surgeon	21	84%
2	General surgeon	19	76%
3	General surgeons performing HPB surgery	9	36%
4	Gastroenterologist	23	92%
5	HPB-trained nurse	9	36%
6	Anesthesiologist	25	100%
7	Anesthesiologists trained in HPB surgery	10	40%
8	Resident Anesthesiologist	16	64%
9	Nurse anesthetists	25	100%
Infrastructure		**Available**	**PECENTAGE**
10	Intensive care unit ICU	18	72%
11	Pretested blood available (blood bank)	20	80%
12	Access to fresh frozen plasma and other fractions	16	64%
13	Functioning X-ray machine	23	92%
14	Functioning intraoperative ultrasound machine	11	44%
15	Functioning intraoperative X-ray machine	15	60%
16	Functioning CT scan within 1-hour drive	18	72%
17	Functioning MRI scan within 1-hour drive	14	56%
18	Interventional radiology availability	5	20%
19	Facility for invasive monitoring	11	44%
20	Facility to achieve safe, low central venous pressure	12	48%
Procedures		**Performed**	**PECENTAGE**
21	Diagnostic and therapeutic ERCP– stenting, sphincterotomy	12	48%
22	Endoscopic ultrasound	9	36%
23	Cholecystectomy– open	24	96%
24	Cholecystectomy– laparoscopic	23	92%
25	Radical cholecystectomy	18	72%
26	Percutaneous liver biopsy	18	72%
27	Intra-operative ultrasound	11	44%
28	Distal pancreatectomy +/- splenectomy	22	88%
29	Whipple procedure	22	88%
30	Local resection of ampullary mass	13	52%
31	Palliative biliary bypass– hepaticojejunostomy	21	84%
32	Palliative biliary bypass- cholecysto-jejunostomy	23	92%
33	Palliative gastric bypass- gastrojejunostomy- Laparoscopic	11	44%
34	Palliative gastric bypass- gastrojejunostomy- Open	19	76%
35	Palliative bypass (for GOO) -gastrojejunostomy - EUS guided	6	24%
36	Palliative Endoscopic Duodenal stenting for GOO.	10	40%
37	Minor hepatic resections (≤ 3 segments)-	22	88%
38	Major hepatic resections (> 3 segments)	20	80%
39	Non-anatomic hepatic resections	23	92%
40	Bile duct resection and reconstruction	22	88%
41	Portal lymphadenectomy	19	76%
42	Klatskin resection	12	48%
43	Ablation of liver lesions	7	28%
44	Trans-arterial embolization	9	36%
45	Liver transplantation	3	12%
Equipment and Supplies		**Available**	**PECENTAGE**
46	Energy device (e.g. Ligasure, Harmonic)	19	76%
47	Electrosurgery (diathermy)	25	100%
48	Liver retractors	17	68%
49	Instrument for fracturing	14	56%
50	Vascular Stapler	13	52%

Table 1 (continued)

Personnel		Available	PECENTAGE
51	Cavitron Ultrasonic Surgical Aspirator (CUSA), Water jet	6	24%
52	Ultrasonic scalpel	9	36%
53	Monopolar sealer (saline drip)	0	0
54	Bipolar diathermy	22	88%
55	Radiofrequency pre-coagulator	4	16%
56	Immunosuppressives for liver transplantation	6	24%
57	Liver sutures	16	64%
58	Sutures	17	68%

Table 2 Character of hospitals/centers that responded to the PIPES survey

NO	Countries	Cities	Responded Surgeons	Hospital	Referral	NO of Beds	Personnel/ 9	Infrastructure /11	Procedure /25	Supply /13	Total score /58
1	Sudan	Kassala	HBP Surgeon	Private	Secondary	130	7	6	15	7	35
2	Sudan	Merowe	HBP Surgeon	Private	Tertiary	150	8	8	14	7	37
3	Sudan	Shendi	General Surgeon	Governmental	Secondary	250	6	4	4	4	18
4	Sudan	Atbara	HBP Surgeon	Governmental	Secondary	60	9	7	17	9	42
5	South Africa	Pretoria	HBP Surgeon	Governmental	Quaternary	1500	7	11	23	12	53
6	South Africa	Johannesburg	HBP Surgeon	Governmental	Quaternary	3000	9	10	24	11	54
7	South Africa	Polokwane	HBP Surgeon	Governmental	Tertiary	500	6	10	18	8	42
8	South Africa	Johannesburg	HBP Surgeon	Governmental	Quaternary	900	6	8	25	7	46
9	South Africa	Johannesburg	HBP Surgeon	Governmental	Quaternary	3500	6	10	24	11	51
10	South Africa	Gauteng	HBP Surgeon	Governmental	Quaternary	900	8	8	22	10	48
11	South Africa	cape town	HBP Surgeon	Governmental	Quaternary	893	8	11	25	13	57
12	Zimbabwe	Harare	HBP Surgeon	Governmental	Tertiary	800	8	3	19	4	34
13	Ethiopia	Mekelle	HBP Surgeon	Governmental	Tertiary	600	7	2	14	7	30
14	Ethiopia	Bahir Dar	HBP Surgeon	Governmental	Tertiary	500	6	5	12	4	27
15	Ethiopia	Bahir Dar	HBP Surgeon	Governmental	Secondary	500	6	8	19	8	41
16	Ethiopia	Addis Ababa	HBP Surgeon	Governmental	Tertiary	900	7	8	16	9	40
17	Ethiopia	Adama	HBP Surgeon	Governmental	Tertiary	220	8	9	8	8	29
18	Somalia	Mogadishu	General Surgeon	Governmental	Tertiary	200	7	8	16	9	33
19	Botswana	Gaborone	HBP Surgeon	Governmental	Tertiary	350	6	8	18	6	41
20	Kenya	Nairobi	HBP Surgeon	Private	Tertiary	100	6	8	18	6	38
21	Kenya	Nairobi	General Surgeon	Governmental	Level 5	1500	5	2	9	6	22
22	Kenya	Kajiado	General Surgeon	Governmental	Secondary	130	4	3	3	8	18
23	Malawi	Blantyre	General Surgeon	Governmental	Tertiary	1200	5	1	11	3	20
24	Uganda	Kampala	HBP Surgeon	Private	Tertiary	241	8	8	20	9	45
25	Zambia	Lusaka	HBP Surgeon	Governmental	Tertiary	1000	7	4	15	7	33

Infrastructures

Functioning X-ray machines and pre-tested blood banks are the most common infrastructures available among 23 (92%) and 20 (80%) hospitals, respectively. ICUs are available in 18 (72%) hospitals. Interventional radiology services are offered in only 5 (20%) hospitals. The median response rate is seven, ranging from two to ten.

Procedures

The most common operation in these HPB departments is open cholecystectomy, performed in 24 (96%) hospitals, whereas Laparoscopic Cholecystectomies were performed in 23 (92%) of the hospitals. Whipple's procedure, bile duct resection and reconstruction, and distal pancreatectomy +/- splenectomy, and minor hepatic resections were performed in 22 (88%) hospitals. Major resections were performed in 20 (80%) hospitals. Liver transplantation was performed in 3 (12%) hospitals.

Equipment

Electro surgery (diathermy) is available in all hospitals, while energy devices (e.g., Ligasure, Harmonic) are available in 19 hospitals. Liver retractors are available in 17. Cavitron Ultrasonic Surgical Aspirator (CUSA), a Water jet, is available in 6 hospitals.

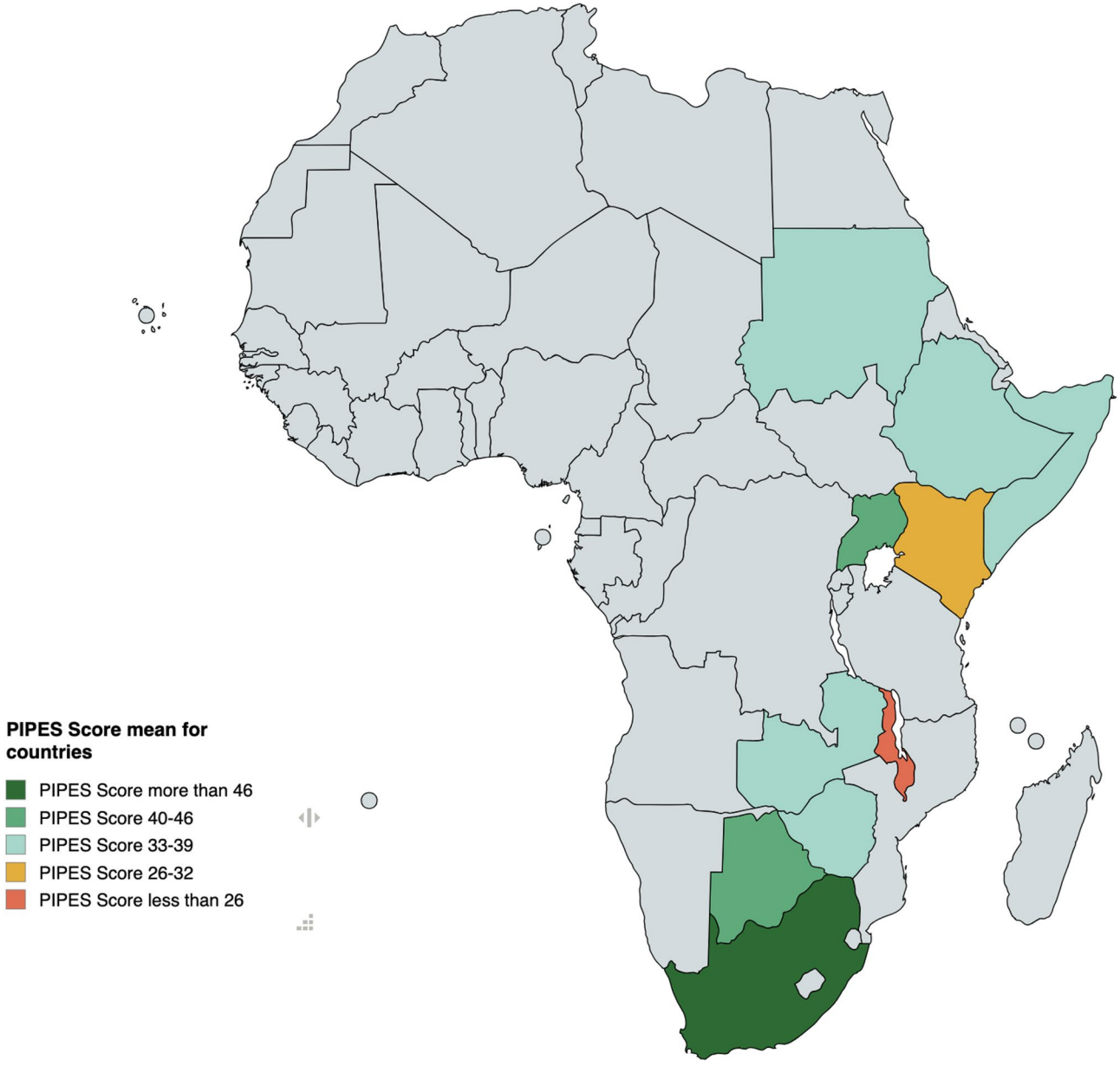

Fig. 1 PIPES score by countries

Discussion

Trained medical personnel are the foundation of providing safe surgical services. However, shortages and disparities in the distribution of the trained surgical workforce exist worldwide. Low- and middle-income countries (LMICs) are particularly affected by the lack of trained personnel; within these countries, the rural areas are grossly suffering [5]. The recommended number ratio of trained healthcare providers is 20/100,000 [5]. In 2015, the World Bank estimated the surgical workforce in Sub-Saharan Africa to be 2/100,000 [9]. Ethiopia is one of the most densely populated countries in East Africa. According to reports, the overall surgical workforce is estimated to be 5.19 per 100,000 people on average and 1.31 per 100,000 in specialized hospitals, reported by Osebo et al. in 2024 [10]. Mozambique's ratio is 1.1/per 100,000 population [11]. The HPB surgery service situation is even worse. Taking Ethiopia as an example, 26 surgeons performed HPB surgeries in 4 different hospitals. Few centers are doing such advanced service with PIPES scores between 24 and 31/58, reflecting that more efforts from the stakeholders must be taken to uplift the service delivery.

The lack of training programs in surgical gastroenterology and HPB surgery in Sub-Saharan Africa contributes to the scarcity of HPB surgeons in the region. Currently,

there are only 27 fellowships listed in the IHPBA fellowship registry across the entire E-AHPBA (Europe, Africa, and Middle East) region. Only two are from Africa (Ethiopia and South Africa), one is from the Middle East, and the rest are in Europe [12]. In this study, some African countries have no HPB surgeons at all, with General Surgeons performing HPB surgeries, while trained HPB surgeons are available in most countries.

The number of pancreatectomies and major HPB operations is directly proportionate to the better outcome [12, 13] and in 2007 Langer reported that 20 pancreatectomies and a total of 50 major HPB operations annually are set as a target for the center volume load in Ontario [14].

Some centers in this survey do not perform pancreatectomies and liver surgeries; in contrast, other centers perform complicated HPB surgeries and even liver transplantation. This heterogeneity raises important questions about the training opportunities available, the level of expertise required and developed, and the availability of the infrastructure to conduct these advanced operations.

The availability of adequate infrastructure is a cornerstone of successful and safe HPB service delivery. This study demonstrates a significant relationship between the PIPES score and the workload and complexity of HPB surgeries. However, there is no statistically significant relationship between the number of beds (hospital size) and the hospital referral capacity. Although most centers or hospitals lack interventional radiology services, procedures were performed at other nearby centers within the same country. HPB surgeries were conducted in Africa, despite the lack of infrastructure in most participating centers; they endeavored to provide high-quality care services.

Besides the intervention radiology, intraoperative US is not available in many centers, which is crucial in some HPB surgeries. Additionally, the General ICU was reported to be available only in 18 centers (72%). Furthermore, invasive monitors are not available in many centers. In this survey, CT scans, MRI scans, and intraoperative US scans are available only in 18 (72%), 14 (45%), and 11 (44)% of hospitals, respectively, these figures reflect the difficulties that the surgeons face in formulating a sound preoperative diagnosis, and as well challenging intraoperative assessment for liver cases, a thing that help in determining the tumor respectability.

Okello Michael et al. 2024 from Uganda reported a 13.6% in-hospital mortality in patients who had palliative open surgery secondary to failure of preoperative diagnosis of unresectable disease as a consequence of preoperative imaging quality [6].

This study is comparable to and complementary to Alatise [8] study, which was conducted in West Africa (Table 3). Both studies can have a wide scope in Sub-Saharan countries. East and southern Africa have more capacity for HPB surgery than West Africa.

Limitation of study This study represents the capacity of HPB surgery; it does not show the actual HPB services. The selection and inclusion of the participants can be biased.

Self-reporting bias, especially reporting procedural capability or underreporting of infrastructural deficiencies, can be considered a second limitation. Failure of communication with some centers and lack of response from others played a part in the adequacy of the region's representation.

Conclusion Many centers **i**n East and Southern Africa offer different ranges of HPB surgeries, while other centers offer a set of basic services. HPB surgery services in East and Southern Africa and sub-Saharan Africa, in general, need a more detailed situation analysis to draw recommendations to improve service delivery.

Table 3 Comparison between the current study and the West Africa study 8

Variables	This study (*N* = 25)	West Africa Study (*N* = 35)
Countries	11	4
Centers (hospitals)	25	35
Governmental hospital	20 (80%)	
Mean score		
Maximum score	56/58	35.6/55
Minimum score	18/58	3.5/55
Personnel		
HPB surgeon	21 (84%)	5 (14.3%)
General surgeon	19 (76%)	35 (100.0)
Gastroenterologist	23 (92%)	31 (88.6%)
Infrastructure		
General ICU	11 (44%)	31 (88.6%)
Pretested blood available (blood bank)	20 (80%)	30 (85.6%)
Interventional radiology availability	5 (20%)	9 (25.7)
Procedures monthly		
Diagnostic and therapeutic ERCP– stenting, sphincterotomy	12(48%)	2 (5.7)
Endoscopic ultrasound	9(36%)	2 (5.7)
Whipple procedure	22(88%)	6 (17.1)
Minor hepatic resections (≤ 3 segments)-	22(88%)	12 (34.2)
Major hepatic resections (> 3 segments)	20 (80%)	5 (14.3)
Trans-arterial embolization	9(36%)	3 (8.6)
Liver transplantation	3 (12%)	0 (0.0)
Equipment and Supplies		
Energy device (e.g. Ligasure, Harmonic)	19 (76%)	9 (25.7)
Liver retractors	17 (68%)	13 (37.1)
Cavitron Ultrasonic Surgical Aspirator (CUSA), Water jet	6 (24%)	2 (5.7)

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Author contributions
MDAG and AAE conceived and collected the idea. TKM and NEM designed the study. All authors wrote the manuscript, read the article, and approved the final version.

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Data availability
All Data use in this study are availabe with the corspondance author.

Declarations

Ethics approval and consent to participate
This study strictly adhered to the ethical standards outlined in the Declaration of Helsinki. Informed consent was obtained from all participants to participate in this study. Ethical approval was obtained from the Faculty of Medicine, University of Gezira, the ethical committee.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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