


Anesthesia Health System Capacities in Public Hospitals of Punjab, Pakistan

INQUIRY: The Journal of Health Care Organization, Provision, and Financing
Volume 58: 1–8
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DOI: 10.1177/00469580211059740
journals.sagepub.com/home/inq


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Abstract

Purpose: This study intends to outline the capacity of anesthesia health system in public hospitals of Punjab, Pakistan.

Methods: A cross-sectional survey among public hospitals of Punjab was carried out that provide emergency and elective surgical care. We measured capacity in terms of infrastructure; surgical, anesthetic, and obstetric (SAO) workforce; surgical interventions; information management; equipment; and medication which was accomplished between October 2020 and February 2021.

Results: Out of 106 public hospitals in Punjab, almost 40% had only one anesthesia provider. Only 50% of the hospitals reported round the clock availability of anesthesia providers for surgical cases. While caesarean sections were carried out in more than 90% of health facilities, general surgery, pediatric surgery, and open fracture surgery were conducted only in 50% of the hospitals. Although local and general anesthetic agents were available in the majority of hospitals, essential medicines for safe anesthesia were not available in all hospitals.

Conclusion: This first comprehensive assessment of anesthesia health system capacity exposed a crucial deficiency of critical supplies and workforce for providing safe anesthesia and, hence, safe surgery. The surveyed facilities had an uneven division of resources.

Keywords

workforce, anesthesiology, surgery, healthcare provision

What do We Already Know About This Topic?

Coverage of anesthetic and surgical capacities is still a neglected global health measure, although disparities in provision of safe surgical and anesthetic care are obvious in low- and middle-income countries.

How Does Your Research Contribute to the Field?

This is the first comprehensive assessment of anesthesia health system capacity in Pakistan.

What Are Your Research's Implications Towards Theory, Practice, or Policy?

Results exposed a crucial deficiency of critical supplies and workforce for providing safe anesthesia and, hence, safe surgery, emphasizing the need for strengthening workforce.

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Introduction

Effective surgical procedures can only be attained with access to standard anesthesia services. Unfortunately, anesthesia is often considered a necessity only at secondary- and tertiary-level medical facilities.¹ However, coverage of anesthetic and surgical capacities is still a neglected global health measure, although disparities in provision of safe surgical and anesthetic care are obvious in low- and middle-income countries (LMICs).¹ Feeble efforts in improving health care provision and sheer neglect of improvements in anesthesia health systems has deprived the access of five billion people globally to safe and affordable anesthesia.^{2,3} In high-income countries, safety of anesthesia has improved gradually over time—not only through improvements in training, provision of medications, and technological developments, but also with the progression in minimum standards for safe practices, updated guidelines, and checklists.⁴ Comparable advancements have not been achieved in low-income settings with poor infrastructure and deficiencies of anesthesia workforce along with lack of essential equipment medication and supplies. Therefore, they are incapable of following the existing standards of high-income regions.^{5,6} It is estimated that at least 143 million added procedures annually are essentially required to decrease disability and death in LMICs from surgical diseases.⁷ Although recommendations describing minimum standards for safe anesthesia practice exist, the number of hospitals fulfilling these standards is not known.

To overcome this issue, the Lancet Commission on Global Surgery recommended at least 20 surgical, anesthetic, and obstetric physicians per 100,000 population by 2030² and 5000 surgical procedures for a population of 100,000. The World Federation of Societies of Anaesthesiologists (WFSA) has developed criteria for safe practice of anesthesia on behalf of 150 countries. These recommendations have been endorsed by World Health Organization (WHO), and these standards are appropriate for anesthesia workforce globally. WFSA envisioned providing supervision and support not only to anesthesia providers, but also their proficient organizations, surgery providing hospital, health facility superintendents, and governments for escalating and improving the quality and safety of anesthesia throughout the world.^{7,8}

These recommendations are also important for a country such as Pakistan, which belongs to the lowermost quartile of the Human Development Index.^{9,10} Within Pakistan, Punjab is the most populated province¹¹ with almost 3000 public level health facilities providing profoundly subsidized services to the public. Among these health facilities, only Tehsil Head Quarters (THQ), District Head Quarters (DHQ), and teaching hospitals provide anesthesia and major surgical facilities. In Punjab, there are a total of 88 THQ hospitals, 34 DHQ hospitals, and 23 teaching hospitals providing anesthesia and surgical care.¹²

Currently, there is no detailed information about anesthesia health system capacity in Pakistan available. Such comprehensive data about health system capacity is an

essential requirement as it could provide an insight into the system's needs at administrative level. This study targets to develop a first detailed assessment of anesthesia capacity in public level hospitals of Punjab which can support the government in improving health facilities.

Methods

Study Design and Sample

This cross-sectional study includes a comprehensive survey of public level hospitals of Punjab Pakistan which are providing surgical services. We used Yamane's formula to calculate the sample size for smaller populations for selecting the number of hospitals

$$n = \frac{N}{1 + N(e)^2} = \frac{145}{1 + 145 \cdot 0.05^2} = 106$$

where, n is the calculated sample size, N equals the population size (number of hospitals in Punjab), and e is the acceptable sampling error. Based on this sample size calculation, the study includes 63 THQ, 25 DHQ, and 18 tertiary level hospitals out of 145 hospitals in Punjab which provide anesthesia services and own a department of anesthesia.

Data Collection

Permissions for data collection was sought from the heads of each hospital. We collected data through paper-pencil-based approach between October 2020 and February 2021. In most secondary level hospitals, the head of the anesthesia department serves as the head of the operating room. Therefore, they were able to respond to each survey question easily, whereas in tertiary level hospitals, where every department has its own operating room, senior registrars of the anesthesia department were approached who gave answers after consulting with equipment and drug in charge of hospitals. We omitted four facilities from the study, because they did not have any anesthesia team of their own.

We used the Anaesthesia Facility Assessment Tool (AFAT)¹³ for data collection. This tool addresses essential recommendations highlighted by WFSA and WHO in order to conduct safe anesthesia practices. It was established to evaluate anesthesia capacity on national level as well as individual capability of hospitals to meet international standards.⁷ Although AFAT resembles numerous previously developed surgical and anesthesia capacity assessment tools,^{14–16} it is precisely focused on anesthesia resources.¹⁷ Every hospital was assessed on the basis of capacity in terms of infrastructure, workforce, information management, surgical interventions, medications, and equipment. The questions posed to study participants are visible in the tables of the results section. A 6-point Likert scale was used to assess the capacity situation as per WFSA recommendations. The availability in hospitals are presented by frequency and percentage as “always” (100%) or “almost always” (76%–

99%), “often” (51%–75%), “sometimes” (26%–50%), “rarely” (1%–25%), and “never” (0%).

Data Analysis

The collected data was transferred using SPSS Version 25. Descriptive statistics were calculated for the survey questions; categorical and continuous variables were reported in absolute numbers and percentages.

Ethical Concerns

The study is part of the doctoral dissertation of the first author. The ethical approval for this study was obtained from the Advance Study Research Board, University of the Punjab (1456/Acad.; February 22, 2020) and Departmental Doctoral Program Committee (D/588/ISCS; June 23, 2020), Department of Public Health, University of the Punjab.

RESULT

This study collected data among 106 public level health facility across Punjab that provided surgical care in 2020/21. The sample consists of 63 THQ, 25 DHQ, and 18 tertiary level teaching hospitals. Anesthesiologists from the surveyed hospitals consist of 66% specialist physicians and 34% non-specialist physicians. Overall, 12.3% said they had less than one year of experience of working at current facility, half of them (51.9%) had working experience of 1–3 years at the current facility, and 35.8% had experience of more than 3 years.

Infrastructure

The basic characteristic of the healthcare facilities in terms of number of beds, surgical wards, post-anesthesia care unit

Table 1. Characteristics of the Hospitals (n = 106).

Items	Responses	n (%)
Inpatient beds in healthcare facility	<50	15 (14.2)
	50–99	47 (44.3)
	100–499	23 (21.7)
	500–999	6 (5.7)
	>999	15 (14.2)
Inpatient surgical wards	Yes	72 (67.9)
	No	34 (32.1)
Operating theatre/rooms	1	36 (34.0)
	2	24 (22.6)
	3	13 (12.3)
	4 or more	33 (31.1)
Presence of intensive care unit	Yes	38 (35.8)
	No	68 (64.2)
Presence of post-anesthesia care unit	Yes	73 (68.9)
	No	33 (31.1)

(PACU), and intensive care unit (ICU) is presented in Table 1. About 80% of hospital consists of less than 500 beds, of which 67.9% of the hospitals have separate surgical wards. Overall, 34.0% of the hospitals have only one operating theatre, whereas 31.1% reported that they have four or more operating theatres, and around 68.9% reported that they had a PACU at their hospitals.

While inquiring about infrastructure, it gets obvious that the majority of hospitals (78%) provide no internet access, while oxygen, running water, and electricity are available almost at every hospital with not a single one reporting its non-availability (Table 2).

Data Management

Half of the hospitals keep records in paper form (50%, n = 53), 10.4% (n = 11) in electronic form, and 30.2% (n = 32) both in paper and electronic form. However, 9.4% (n = 10) keep their records neither in paper nor in electronic form.

Charts are always accessible across multiple visits for the same patient at 30.2% of hospitals, whereas details of each anesthetic procedure (including preoperative assessment anesthesiologists plan, and intraoperative and post-operative management) are documented in anesthetic record at 57.5% of hospitals. Surgical cases in theatre logbook are recorded by 83% of hospitals every time, and only 36.8% of hospitals collect data prospectively for patients’ outcomes (adverse events) post-operatively, such as surgical site infection, stroke, or deep vein thrombosis. Yet, 31.1% report it is never collected. In addition, the majority of surveyed hospitals (62.3%) never conduct morbidity and mortality reviews for quality improvement and never report it to higher authorities (Table 3).

Surgical, Anesthesiology and Obstetric Workforce

Overall, 44.3% of respondents reported that they had 4 and more physicians providing services in the anesthesia department. On the contrary, 41.5% of hospitals employed only one or even no physician for anesthesia services. Only 22.6% had consultant anesthesiologists and 16.0% non-consultant anesthesiologist trainees at the facility working. The majority of hospitals (55.6%) employed 4 and more surgeons and gynecologists. Around 40% of the surveyed hospitals also had 4 or more miscellaneous staff (including scrub nurses and technicians), while 37.7% had only one or no staff available (Table 4).

Workforce Availability

Across Punjab, full time surgical providers, obstetrician/gynecologist, and theatre (scrub) nurses are always available at 56.6%, 78.3%, and 73.6% of hospitals, respectively. Physician (specialist) anesthesiologists are always available

Table 2. Infrastructure (n = 106).

Items	Always n (%)	Almost always n (%)	Often n (%)	Sometimes n (%)	Rarely n (%)	Never n (%)
How often are you able to access internet that is provided by this facility?	14 (13.2)	0	4 (3.8)	3 (2.8)	2 (1.9)	83 (78.3)
How often is oxygen available?	102 (96.2)	2 (1.9)	2 (1.9)	0	0	0
How often is running water available?	98 (92.5)	7 (6.6)	1 (.9)	0	0	0
How often is electricity available?	100 (94.3)	5 (4.7)	1 (.9)	0	0	0

Table 3. Data Management (n = 106).

Items	Always n (%)	Almost always n (%)	Often n (%)	Sometimes n (%)	Rarely n (%)	Never n (%)
How often are charts accessible across multiple visits for the same patient?	32 (30.2)	15 (14.2)	9 (8.5)	11 (10.4)	23 (21.7)	16 (15.1)
How often are the details of each procedure (including preoperative assessment, anesthetic plan, intraoperative and post-operative, management) documented in an anesthesia record?	61 (57.5)	11 (10.4)	6 (5.7)	10 (9.4)	7 (6.6)	11 (10.4)
How often are surgical cases that are done in the operating theatres recorded in a theatre book or logbook?	88 (83.0)	4 (3.8)	1 (.9)	2 (1.9)	4 (3.8)	7 (6.6)
How often data are prospectively collected for patient outcomes (adverse events) post-operatively, such as surgical site infection, stroke, deep vein thrombosis, etc.?	39 (36.8)	10 (9.4)	5 (4.7)	11 (10.4)	8 (7.5)	33 (31.1)
	<i>As needed</i>	<i>Daily/Weekly</i>	<i>Monthly</i>	<i>Quarterly</i>	<i>Annually</i>	<i>Never</i>
How often does this facility conduct morbidity & mortality reviews for quality improvement?	27 (25.5)	4 (3.8)	5 (4.7)	1 (.9)	3 (2.8)	66 (62.3)
How often is this facility required to report morbidity & mortality information to the Ministry of Health or an equivalent agency?	25 (23.6)	5 (4.7)	1 (.9)	9 (8.5)	0	66 (62.3)

Table 4. Surgical, Anesthesiology, and Obstetric Workforce (n = 106).

Items	Responses	n (%)
Anesthesia services	0-1	44 (41.5)
	2-3	15 (14.2)
	≥4	47 (44.3)
Number of surgeons	0-1	42 (39.6)
	2-3	18 (17.0)
	≥4	46 (43.4)
Number of gynecologists	0-1	30 (28.3)
	2-3	17 (16.0)
	≥4	59 (55.6)
Number of other staff (scrub nurses, technicians)	0-1	40 (37.7)
	2-3	24 (22.6)
	≥4	42 (39.7)
Consultant anesthesiologist trainees working at the hospital	Yes	24 (22.6)
	No	82 (77.4)
Non-consultant anesthetists trainees working at the hospital	Yes	17 (16.0)
	No	89 (84.0)

Table 5. Availability of Staff in the Hospitals (n = 106).

Items	Always n (%)	Almost always n (%)	Often n (%)	Sometimes n (%)	Rarely n (%)	Never n (%)
Physician (specialist) anesthesiologist	53 (50.0)	15 (14.2)	6 (5.7)	9 (8.5)	0	23 (21.7)
Anesthesia residents/trainees	33 (31.1)	4 (3.8)	1 (.9)	3 (2.8)	0	65 (61.3)
Non-specialist physician anesthetists	35 (33.0)	8 (7.5)	3 (2.8)	6 (5.7)	0	54 (50.9)
Nurse anesthetists	13 (12.3)	4 (3.8)	2 (1.9)	3 (2.8)	1 (.9)	83 (78.3)
Non-physician, non-nurse anesthetists	8 (7.5)	3 (2.8)	2 (1.9)	2 (1.9)	0	91 (85.8)
Other anesthesia providers	21 (19.8)	4 (3.8)	4 (3.8)	1 (.9)	0	76 (71.7)
Surgical provider	60 (56.6)	5 (4.7)	3 (2.8)	3 (2.8)	0	35 (33.0)
Obstetrician/gynecology provider	83 (78.3)	9 (8.5)	1 (.9)	2 (1.9)	0	11 (10.4)
Theatre (scrub) nurse	78 (73.6)	10 (9.4)	5 (4.7)	1 (.9)	0	12 (11.3)

Table 6. Response of Hospital Logbook Regarding Number of Surgical Cases (n = 106).

Items	Responses	n (%)
Number of surgical cases performed at this facility in the past 12 months	0–99	14 (13.2)
	100–299	18 (17.0)
	300–499	5 (4.7)
	≥500	69 (65.1)
Number of open fractures repaired at this facility in the past 12 months	0–99	68 (64.2)
	100–299	9 (8.5)
	300–499	2 (1.9)
	≥500	27 (25.3)
Number of caesarean sections performed at this facility in the past 12 months	0–99	18 (17.0)
	100–299	4 (3.8)
	300–499	6 (5.0)
	≥500	78 (73.6)

Table 7. Surgical Interventions Offered by the Hospitals (n = 106).

Items	Responses	n (%)
Are open fractures surgically repaired at this health facility?	Yes	57 (53.8)
	No	49 (46.2)
Are laparotomies (e.g., uterine rupture, ectopic pregnancy, acute abdomen, intestinal perforation, traumatic injuries) performed at this health facility?	Yes	63 (59.4)
	No	43 (40.6)
Are caesarean sections performed at this health facility?	Yes	98 (93.0)
	No	8 (7.0)
Are surgical cases performed on children (aged <5 years) at this health facility?	Yes	60 (56.6)
	No	46 (43.4)
Is epidural anesthesia performed at this facility?	Yes	34 (32.1)
	No	72 (67.9)

at half of the hospitals, whereas anesthesia residents/trainees are always available at 31.1% of hospital; more than 60 of hospitals reported that they were never available. Non-specialist physician anesthetists are always available in only 33% of hospitals, while nurse anesthetists were not available at 78.3% of hospitals. Subsequently, non-physicians, non-nurse anesthetists are never available at 85.8% of hospitals, while other anesthesia providers are not available at the majority of 71.6% of hospitals (Table 5).

Surgical Interventions

According to the hospital logbooks, more than 500 surgical cases within the past 12 months have been performed at 65.1% of hospitals. Surgical cases were performed on children (aged <5 years) by 56.6% of hospitals (Table 6), whereas laparotomies (e.g., uterine rupture, ectopic pregnancy, acute abdomen, intestinal perforation, and traumatic injuries) were performed by 59.4%. More than half (53.8%) of hospitals

reported that they also performed open fractures surgically (Table 7), but only 25.5% of them reported to perform more than 500 cases per year. The vast majority of hospitals (93.0%) performed caesareans in their facilities (Table 6), and 73.6% of all hospitals performed even more than 500 cases in the past 12 months (Table 7).

Availability of Anesthesia-Related Medication

Most of essential medication, proven on WHO-WFSA standards, were available among hospitals of Punjab (Supplementary Table 1). For example, ketamine IV/IM is always available at 55.7% of hospitals, and 25.5% of hospitals confirm the unlimited availability of meperidine (pethidine) IV/IM. However, morphine IV/IM is not available at 83.0% of hospitals. Nalbuphine and paracetamol is available at more than 75% of the hospitals (at least temporarily), while NSAIDs (non-steroidal anti-inflammatories) IV or PO is not available in almost half of the hospitals (50.9%). Fentanyl IV and tramadol are available in just one quarter of the surveyed hospitals. A detailed overview regarding the availability of anesthesia-related medication is provided in Supplementary Table 1. Among these 60 medications, six were never available in any hospital, and no medication was always available in all hospitals.

Availability of Anesthesia-Related Equipment

Furthermore, 46.2% (n = 49) had 0–1 anesthesia machine, 20.8% (n = 22) had 2–3 machines, 12.3% (n = 13) had 4–5 machines, and 20.8% (n = 22) had more than 5 machines at their facility. In regard to mechanical ventilators, 53.8% (n = 57) of hospitals had 0–1 machine, 16.0% (n = 17) had 2–3 machines, 14.2% (n = 15) had 4–5 machines, and 16% (n = 17) had more than 5 mechanical ventilators at their facility.

A detailed overview on further equipment's availability is provided in Supplementary Table 2. Some equipment is available at all hospitals at all times. However, for example, defibrillator, self-inflating breathing bag/mask, manual or electric suction pump, stethoscope, and thermometer are always available only at 80–90% of hospitals. Furthermore, functioning X-ray machines (34.9%, n = 37) and functioning ultrasound machines (19.8%, n = 20), blood gas analyzers (16.0%, n = 17), continuous waveform capnography (17.9%, n = 19) and spot check capnography (15.1%, n = 16), as well as hemoglobin measurement devices (15.1%, n = 16) are seldomly always available.

More than half of the respondents (56.5%, n = 60) reported that non-functioning equipment cannot be repaired onsite by staff at the facility. However, there is also a large fraction (37.7%, n = 40) which cleans and re-uses disposable equipment (e.g., endotracheal tubes or laryngeal airway mask) (Supplementary Table 2).

Discussion

This research defines existing anesthesia capacities of Punjab, Pakistan—the province with highest population and considered advance in terms of health and education facilities. The areas with leading concern were recognized in terms of workforce insufficiencies, basic anesthetic infrastructure deficiencies, as well as medications and lack of equipment.

This study found that the majority of hospitals across Punjab reported uninterrupted oxygen, electricity, and running water supply, which is considered as minimum standards for safe provision of surgical and anesthetic care among hospitals.⁷ However, there are also other countries, which do by far not meet the standards, such as Afghanistan, where only 40% of hospitals have access to running water¹⁸ and Gambia with 50% permanent availability of water.¹⁹ Almost one third of the public hospitals in Punjab have a single operation theatre (mainly in THQs), which roughly makes one operating theatre per 250,000 population. This is far from international standard of two operating theatres per 100,000 population.^{20,21} Likewise, a deficiency of proper PACU and ICU was also identified. Previously, there has been data scarcity on post-operative anesthesia care, pain management, and critical care services in low-income countries of South Asia.^{1,22} Though, a study from Africa found that the majority of post-operative deaths occurred in anesthesia recovery rooms and ICUs, thus putting a light on the significance of standardized perioperative infrastructure.²³

As for workforce WFSA recommends, a minimum of five consultant anesthesiologist for a population of 100,000 is needed.²⁴ In Punjab, unfortunately along with non-specialist physician anesthetists, anesthesia trainees, and non-physician anesthesia providers, the workforce density is almost one per 100,000 people, which is more than in neighboring countries like Bangladesh (.58 per 100,000 population) and Afghanistan (9 anesthetist in total), but slightly less than India (1.27 per 100,000 population).^{24,25} This deficiency of anesthesia workforce is substantial, as it results in decreased surgical capacities, along with poor surgical outcomes.^{26,27} According to our study, the problem is more evident in rural areas of Punjab, where the maldistribution of anesthesia workforce is more distinct. This is also evident in neighboring countries.^{18,23–25} In addition, SAO density is also extremely lower than the value of 20 per 100,000 population recommended by the Lancet Commission on Global Surgery.² Most of the hospitals (mainly THQs) have a SAO density of 5 per facility which is serving a population of more or less 1,000,000, where there is one anesthetist mostly, one or no surgeon, along with three or more gynecologists. Although for serious and extensive cases, DHQ or teaching hospitals are available, having a saturation of surgeons, gynecologists, and anesthetists; this startling inconsistency between secondary- and tertiary-level hospitals greatly affects surgical outcomes and increases morbidity and mortality ratios.²⁸ However, the condition is still better than in other LMICs,

like in Sierra Leone, only 10 surgeons are available for a population of 5.7 million, and in Afghanistan, only 9 anesthetists for a population of 32 million, 27 in Uganda for a population of 27 million, and 8 in Bhutan. Moreover, 30% of hospitals in Afghanistan do not have a gynecologist.^{24,28,29}

This study found that more than 90% of the public hospitals in Punjab have at least one anesthetist. Although this is insufficient, the situation is still better than in many other LMICs.³⁰ On the other hand, this study indicates maldistribution of anesthesia providers in addition to insufficiency, with THQ hospitals suffering the worst. There is a dire need for provision of incentives to upscale the anesthesia workforce at THQ and DHQ. Non-physician anesthesia providers (anesthesia technologists) are also seen in few DHQs and THQs, which share a substantial burden of the anesthesia provision in densely populated areas like other LMICs.^{1,22,24} Government-controlled efforts are required to improve opportunities for anesthesia technologists and nurse anesthetist training to overcome the service provision gap in THQ hospitals, particularly in southern Punjab.

Under the domain of surgical interventions, the condition for gynecological interventions seems satisfactory, as 93% of hospitals across Punjab provide caesarean facilities and the remaining still offer normal vaginal deliveries, unlike many African and Asian countries (i.e., Gambia, Tanzania, and Afghanistan) where almost half of the hospitals do not provide these facilities.³¹

While discussing the supply of medications in hospitals of Punjab, it was robust as compared to other provinces and many other LMICs.^{1,21} Though insufficiencies are still present, especially at THQ and DHQ, where anesthesia-related drugs are unavailable. Fortunately, most of intra-operative monitoring standards were fulfilled by the majority of health facilities in Punjab. For example, pulse oximetry was described as always available in 99% of hospitals which is quite better when compared to outcomes of multiple other global surveys LMICs.^{1,22,31} However, capnography was scarce, even after availability at many facilities, but showing maintenance issues. Its availability was not relatable with the location or size of hospital. Moreover, defibrillators in operating theatres was non-existent at many Tehsil level hospitals. Overcoming this gap is immediately required in order to improve the safety of patients.

Limitations

Regardless of being the first most extensive anesthesia capacity assessment in Pakistan, our study still has numerous limitations. First of all, it just covers a province of Punjab, whereas it is required all over the country to get a real picture of available resources. Secondly, it did not cover private, non-profit, social security, or military hospitals. Moreover, this data was reported by heads of anesthesia departments or senior registrars at each hospital instead of autonomous observers. This may lead to biases, but can also offer a useful

way where hospitals can respond to the tool themselves. Finally, only quantitative tools might not completely apprehend the actual cause behind surrounding resource insufficiency. Therefore, qualitative analyses are needed to better apprehend the origins of anticipated problems and suggest solutions.

Conclusion

This is the first ever province wide, comprehensive evaluation of anesthesia capacities in public hospitals of Punjab, Pakistan, which reveals key insufficiencies in terms of workforce, infrastructure, medicines, and equipment. This study brings into notice the fragile condition of public level hospitals in Punjab, where the majority of hospitals meet only a few WHO-WFSA criteria. There is a critical deficiency of anesthesiologists (both physician and non-physician) including other SAO providers. This study reveals that dedicated investments in terms of escalating anesthesia workforce and accessibility to anesthetic/pain managing medications and equipment would not only improve surgical outcomes but also patient satisfaction in addition to decreasing surgical disease burden. This assessment undoubtedly provides ground level data to reform policies for guaranteeing the accessibility of vital resources and makes a base for improving upcoming service delivery regimen for provision of safe anesthetic and surgical care in Pakistan.

Author's Contributions

Sumbal Shabaz and Rubeena Zakar conceptualized the study. Data collection and analysis was performed by Sumbal Shabaz and supervised by Rubeena Zakar and Florian Fischer. The first draft of the manuscript was written by Sumbal Shabaz; and Rubeena Zakar and Florian Fischer revised the manuscript for important intellectual content. All authors read and approved the final manuscript.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The authors received no financial support for the research, authorship, and/or publication of this article.

Ethical Approval

The ethical approval for this study was obtained from the Advance Study Research Board, University of the Punjab (1456/Acad.; February 22, 2020) and Departmental Doctoral Program Committee (D/588/ISCS; June 23, 2020), Department of Public Health, University of the Punjab.

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Supplemental Material

Supplemental material for this article is available online.

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