


BMJ Open Assessment of anaesthesia workforce capacity in district and tehsil (taluka) hospitals in Sindh province of Pakistan: a survey

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To cite: Khuwaja A, Tabassum R, Soomro A, *et al.* Assessment of anaesthesia workforce capacity in district and tehsil (taluka) hospitals in Sindh province of Pakistan: a survey. *BMJ Open* 2023;**13**:e072807. doi:10.1136/bmjopen-2023-072807

► Prepublication history and additional supplemental material for this paper are available online. To view these files, please visit the journal online (<http://dx.doi.org/10.1136/bmjopen-2023-072807>).

Received 21 February 2023
Accepted 15 May 2023



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ABSTRACT

Objectives Our objective was to determine the current availability of human resource at secondary care hospitals in Sindh province and to identify gaps in term of appropriate number of anaesthesiologists available for delivery of safe anaesthesia care.

Design A cross-sectional survey of anaesthesia workforce.

Setting All district and taluka hospitals in the Sindh province of Pakistan.

Participants Administrative anaesthesia leaders in the hospitals.

Outcome measures Standard descriptive statistics (percentages and numbers) of anaesthesia workforce in these hospitals including both full-time and part-time physician anaesthesiologists, and non-specialist physicians providing anaesthesia services as well as technician support.

Results Only 54 (75%) hospitals had a full-time anaesthesia physician, and 32 of these had only one. Two hundred and one operating rooms were present in 72 (80%) hospitals with an average of three operating rooms/hospital.

Conclusions This study has identified a deficit of anaesthesiology personnel in district-level and tehsil-level hospitals of Sindh province of Pakistan.

INTRODUCTION

Universal access to safe surgery by 2030 requires a parallel increase in access to safe anaesthetic care, especially in lower and lower-middle-income countries (LMICs) where improvements are needed in workforce, equipment/supplies, essential medication and other infrastructure.^{1 2} In order to provide accessible surgical care for bellwether procedures at the level of secondary care hospitals, an initial assessment of existing anaesthesia services is required that will allow for better future planning of services.

Pakistan has a three-tiered government healthcare system. Since 2018 healthcare in the country is devolved to the provincial level and each province is responsible for its

STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ The strength of this survey is that all government hospitals in the province were included and reported in the survey.
- ⇒ Standard descriptive statistics (percentages and numbers) were used to summarise the data.
- ⇒ No site visits were done to confirm the data.
- ⇒ We did not look at the other aspects of service such as actual workload, and availability of equipment and medications.

healthcare systems. The anaesthesia setup and the training of the anaesthesiologists in the province is given in online supplemental appendix 1.

Anaesthesia services are required at both tertiary and secondary level hospitals. Tertiary care hospitals are located in big cities, but secondary hospitals, that is, tehsil headquarter hospitals (THQ) (known as taluka hospitals in Sindh) and district headquarter hospitals (DHQ) are the healthcare facilities that are accessible to a majority of population residing in smaller towns and cities and in rural areas.³ Currently, there is little information about the anaesthetic facilities at these DHQ and THQ hospitals.

Sindh is the second largest province of Pakistan. According to the last census done in 2017, the population of Sindh was 47.9 million with an urban population of 52%.⁴ It has 7 divisions and 29 districts.⁵ These districts are shown in [figure 1](#). At present, the state of readiness of these hospitals to respond to anaesthesia care needs of the population is not known. Due to financial constraints in conducting a large study to look at all aspects of anaesthetic care, we decided to initially look at the availability of only human resources for anaesthesia provision in the province at the DHQ and THQ



Figure 1 Districts of Sindh province.

hospitals. This is as an initial step, and we plan to use this information later to get funding and further details on other aspects.

The aim of this project was to gather preliminary data regarding the human resources available at the DHQ and THQ hospitals in Sindh. Our specific objectives were to determine the current availability of human resource at secondary care hospitals in Sindh province and to identify gaps in term of appropriate number of anaesthesiologists available for delivery of safe anaesthesia care and to recommend measures to overcome the deficiency.

METHODOLOGY

Our study design was a cross-sectional survey. Our study tool was a structured questionnaire designed for use at the secondary care hospitals in Sindh province (online supplemental appendix 2). The main elements of this tool were taken from the workforce section of Anaesthesia Facility Assessment Tool of World Federation of Societies of Anaesthesiologists (WFSA)⁶ but additional questions were added to cover the local perspective by a committee of three experts (FK, AK and RT). Standardised definitions were provided for physician (specialist) anaesthesiologist,

non-specialist physician anaesthesiologist and anaesthesia technicians. The additional information asked for related to the number of anaesthesia technicians working at the facility, and rotation of anaesthesia physician trainees at the site. Since we do not have nurse anaesthetist or non-physician anaesthesia caregivers in the country, we did not include this information in our tool. The survey form was tested and modified in one of the hospitals. The tool addressed the following areas: the name of the health-care facility, division and district in which the hospital was located, information regarding the number of operating rooms (OR) in the facility, number of anaesthesiologists working in the facility including full-time or part-time specialist physician anaesthesiologists, non-specialist physician anaesthesiologists and other anaesthesia providers (nurses/technicians), number of anaesthesia technicians at the facility, number of anaesthesia trainees at the facility, number of surgeons working at the facility (both specialist and non-specialist) and number of gynaecologists/obstetricians (specialists and non-specialists) working at the facility. The form also included a free-text comments section.

All government owned DHQ and THQ hospitals of Sindh province were surveyed. Study participants were the anaesthesiologists working in these hospitals. If there were more than one anaesthesia physician in the facility/hospital, the anaesthesia doctor who was administrative in-charge was the contact person.

The following data collection procedure was followed: a list of all DHQ and THQ hospitals was compiled after obtaining information from the websites of the Sind Health Care department⁷ and use of personal contacts. Contact details of the hospitals and the anaesthesiologists working in those hospitals were obtained. A research committee was established, and co-ordinators (anaesthesiologists) were identified who were already based in different divisions of the province (AS, RD, KK and JA). These co-ordinators were provided list of government hospitals in their designated areas who then identified and contacted the anaesthesia doctors in-charge of different hospitals on telephone. A verbal informed consent was obtained for acceptance to participate in the study. All were explained the purpose of the study and any queries raised were satisfied. A telephonic interview was scheduled with these anaesthesiologists to get the required information. A hard copy of a consent form and survey form were also sent to the doctors via email or on their postal address if email was not available, which the local anaesthesiologist was requested to fill and return. The filled forms were returned by the coordinators to the principal investigator (PI). If any of the hospital did not have an anaesthesia contact, the administrator of the hospital was contacted to confirm the information.

The project did not have a budgetary requirement. All interviews were conducted by the PI and Co-PIs in their own time and using their personal phones.

Patient and public involvement

None.

Data management and analysis

Confidentiality was maintained by keeping the data under lock and key and only PI had access to the complete data. The names of the hospitals were anonymised before summarising the data and each hospital was given a number. A separate decoding list was maintained by the PI.

The collected data for each individual hospital was entered into a Microsoft excel sheet. It was then accumulated for each division, namely Banbhore, Hyderabad, Karachi, Sukkur, Larkana, Mirpur Khas and Shaheed Benazirabad. Descriptive statistics were run to calculate the averages, frequencies and percentages for number of OR, anaesthesiologists, anaesthesia technicians, specialist surgeons and obstetricians. The results are presented for whole province and for each division as well.

RESULTS

This survey was conducted between 1 September 2021 and 30 January 2022 (5 months).

The overall anaesthesia physician workforce density per 100 000 population in Sindh province was found to be 0.26 (population of Sindh province 47 886 051).⁸

There were a total of 90 taluka (THQ) and district (DHQ) hospitals and 201 OR in the province. We had a response from all 90 hospitals regarding anaesthesia staffing. Eighteen of the hospitals (20%) did not have an OR. Hence, 201 ORs were present in 72 (80%) hospitals with the average of 3 OR/hospital. The anaesthesia services were being provided by 125 full-time qualified physician anaesthesiologists (possessing diploma or membership qualifications of CPSP). Only 54 (54/72; 75%) hospitals had full-time qualified anaesthesia physicians supplemented by six part-time qualified anaesthesiologists working with them. Exploring further, out of those 54 hospitals, only 32 (32/54; 59%) had one full-time anaesthesiologists (table 1).

In 23 hospitals, additional services were being provided by 54 full-time non-specialist physician anaesthesiologists. These were physician anaesthesiologists who had partially completed or completed their training requirement for the diploma or MCPS examination but had not sat or passed the certification examinations. In 18 of these hospitals (18/23), they were working with qualified anaesthetists but in 5 hospitals (5/23) they were providing independent services. There were seven other anaesthesia providers listed in three hospitals who were working under supervision of qualified anaesthetists. These were doctors with an MBBS degree with no proper structured anaesthesiology training but had experience in working under supervision in anaesthesia departments, in contrast to the 54 non-specialist physician anaesthesiologists who had undertaken (though not completed) formal training programmes.

Table 1 Distribution of physician anaesthesia providers in district and taluka hospitals of Sindh province

Distribution of anaesthesia providers	Hospitals (%) n=72
Hospitals staffed with more than one qualified* specialist anaesthesiologist	22 (30.5)
Hospitals staffed with only one qualified* specialist anaesthesiologist	32 (44.4)
Hospitals where highest level provider is a full-time non-qualified physician anaesthesiologist†	5 (6.9)
Hospitals where the highest level anaesthesia provider has not had any formal training	0 (-)
Hospitals with operating rooms but no anaesthesia provider on staff	13 (18.0)

*Graduate of a medical school who has completed a nationally recognised specialist anaesthesia training programme/residency.
 †Graduate of a medical school who has not completed a nationally recognised specialist anaesthesia training programme or does not have certification, but has undergone some formal training.

The anaesthesia physician workforce in Sindh province was supported by 67 anaesthesia technicians working in 78 (78/90; 87%) hospitals. There were no nurse anaesthetists present in any of the hospitals. The exact surgical and obstetrical workload was not ascertained but there were 221 full-time surgeons and 178 full-time obstetricians based in these hospitals, supplemented by 27 non-specialist surgeons and 145 non-specialist obstetricians.

The ratio of qualified full-time anaesthesiologists to full-time surgeons working in these government hospitals was 1:1.8, that is, one qualified anaesthesiologist to 1.8 surgeons, and ratio to full-time obstetrician was 1:1.4, that is, one qualified anaesthesiologists to 1.4 obstetricians.

Online supplemental table 1 shows the distribution of ORs, anaesthesiologists, anaesthesia technicians, specialist surgeons and obstetricians in the seven division of Sindh province. Online supplemental table 2 shows the number of hospitals, OR and anaesthesia workforce in districts of Sindh province. **Figure 2** shows the anaesthesia, surgical and obstetric workforce of full-time physicians in relation to the population in each division. The percentages are calculated from the respective total.

DISCUSSION

These results point to a critical shortage of human resource in anaesthesia staffing of the government run DHQ and taluka hospitals. These are the non-teaching service providing institutions that serve the majority of the rural and urban population of the province, the majority of which are located in smaller towns and cities. We found that the ratio of qualified anaesthesiologists to surgeons and obstetricians was 1.8 and 1.4, respectively. Forty four per cent of hospitals had only one anaesthesiologist for both routine and emergency work. This kind of over-work may lead to burn-out characterised by emotional exhaustion, low sense of personal accomplishment and

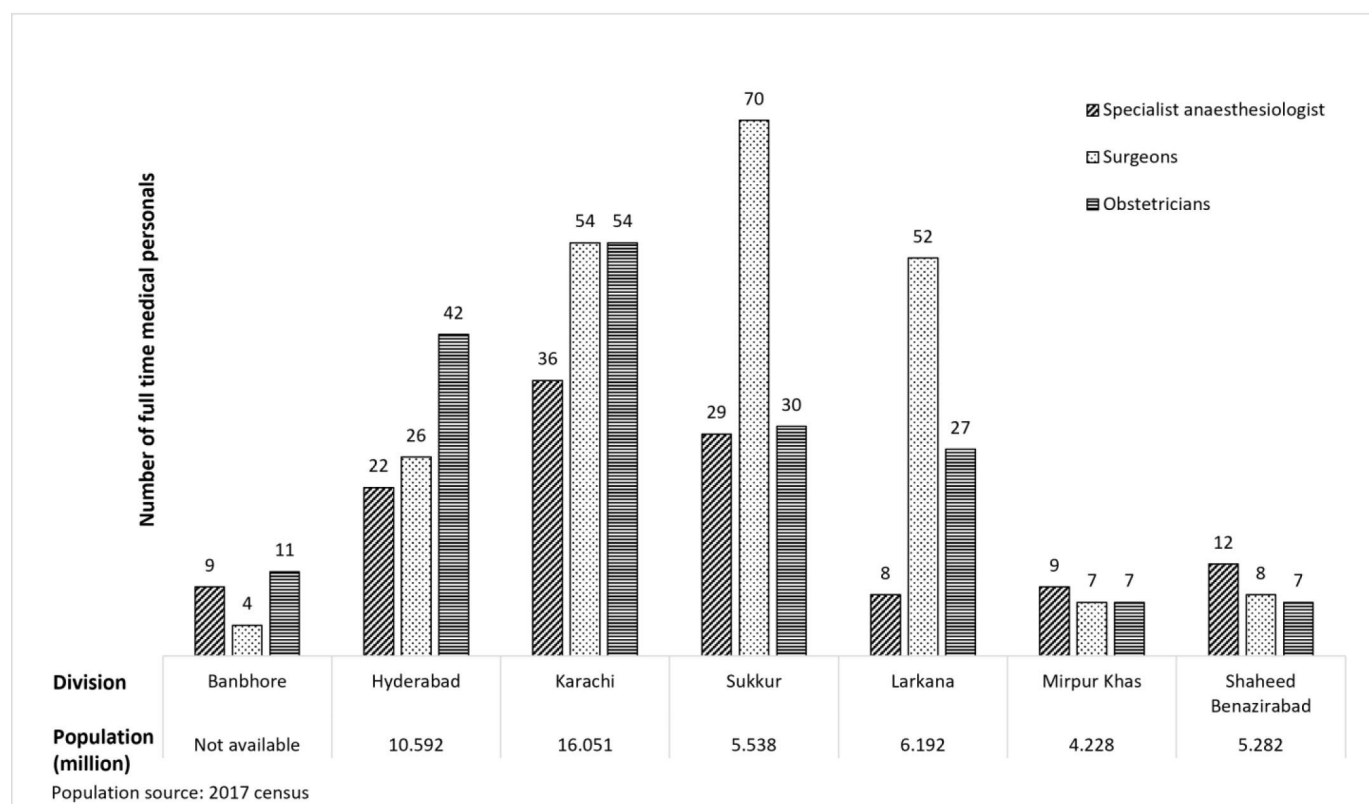


Figure 2 Anaesthesia, surgical and obstetric workforce of full-time physicians in the seven divisions of Sindh province in relation to the population.

depersonalisation.⁹ Work overload has been identified as one of the factors related to burnout in anaesthesiology whether due to uneven distribution of anaesthesiologists in different regions or due to excessive night on call commitments.¹⁰ In five hospitals, anaesthetic service was provided by a non-specialist anaesthesia provider. We did not explore the supervision of these anaesthesiologists and what happened if they needed any help in case management.

A survey conducted by the WFSA in 2018 listed that Pakistan had only 1.6 anaesthetists per 100 000 population.¹¹ They had divided the countries based on regions classified by the WHO as well as the World Bank Income groups. Pakistan falls in the LMIC group. The distribution of physician anaesthesiologists per 100 000 numbers in LMIC countries was 1.78, compared with upper-middle-income and high-income countries (HICs) where this ratio was 6.89 and 17.96, respectively.¹² The minimum recommended number by these authors was 5 per 100 000 population. Most of the anaesthesiologists in our country are concentrated in large cities leaving inadequate anaesthetic coverage in smaller towns.¹³ This situation also exists in some HIC and is not an exclusive issue of LMIC alone.¹⁴ Anaesthetic technicians had no role in patient management. Their primary responsibility was helping the anaesthesiologists in setting up and functioning of apparatus and conduct of service. Nearly 50% possessed a diploma and were appointed to government service whereas others were on contractual commitment and had only on-job training. The WFSA views anaesthesiology as a medical practice but also recognises the fact that this standard may not be achieved in many countries. They recommend that 'wherever anaesthesia is provided by non-anaesthesiologists, these providers must be directed and supervised by anaesthesiologists in accordance with their level of training and skills'. Based on our result of human resource deficit in anaesthesiology, these hospitals in Sindh province need both short-term and long-term planning. Such planning will of course need more input from all areas of anaesthesia, surgery and obstetrics and gynaecology. Government officials should not unilaterally decide on solutions without involving anaesthetist as has happened in the past. Some of the solutions are discussed below.

Different models of care have been practised in other parts of the world where task sharing has taken place with family practitioners, nurses or technicians, wherever there was shortage of physician anaesthesiologists. Some of these models have been successful in African and other countries.^{15 16} However, there are several problems in implementing this model in Pakistan. In many countries including some HICs, nurse anaesthesiologists supplement the physician anaesthesiologist's workforce. In Pakistan, the specialty is still viewed as a medical specialty and no career path or training is available for nurses. Pakistan also has a unique problem where there is a shortage of nurses compared with doctors, and nurse doctor ratio is reversed.¹⁷ Task sharing with family practitioners

is also practised in countries such as Canada. Alberta Family Physicians prog 1 year is a programme for family physicians, who acquire additional technical and cognitive skills in anaesthesia to augment family medicine training.¹⁸ Another example from the USA is the Family Practice Anaesthesia Enhanced Skills Residency; this is an additional third year added to the family medicine residency programme with specific objectives to provide residents with appropriate skills necessary to practice safe anaesthesia for uncomplicated procedures during their family medicine practice.¹⁹ However, in Pakistan to date, no anaesthetic training is part of family practice curriculum. If chosen, this option will need careful and long-term planning as well as a buy-in from government authorities and professional societies.

A better model that has been proposed for Pakistan is the expansion of services of middle grade anaesthesiologists and develop a mechanism of their further support and means of continuous professional development.¹³ One of the problems identified in this recent publication was the concentration of anaesthetists in urban setting due to various reasons. This has been overcome to some extent in another province of Pakistan by giving economic incentives.²⁰ If this route is to be taken, a network of support will need to be established through internet facility available throughout the country. WhatsApp groups are also being used to give assistant for difficult cases. There can be a role of tertiary care teaching hospitals present in larger cities. This can be done by senior resident rotations, short faculty visits and hands on courses.

The strength of this survey is that it is the first such survey done in the country. It has attempted to measure the anaesthesia workforce at the district and taluka hospitals which provide the first line routine and emergency services for surgical and obstetrical anaesthesia. No previous data was available. These data will provide gaps and suggestions that will help in future planning of human resources. There are some limitations as well. The survey was conducted by a telephonic interview supplemented by a hard copy of the survey form, no site visit was done to confirm the findings. The possibility of absence of social desirability bias cannot be guaranteed, but we did attempt to overcome this by explaining the purpose of the survey and its impact on improving patient safety and keeping the identity of the responder and hospital anonymous.

CONCLUSION

The study has documented the anaesthesia workforce available in the government run hospitals in the Sindh province of Pakistan and the shortage of qualified anaesthesiologists in this setting. Only 75% of the hospitals had a qualified anaesthesia physician. This information is still incomplete, and more information and comprehensive data is needed on routine and emergency workload, available equipment and medication. This requires a more



detailed follow-up survey to overcome these information deficits.

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Acknowledgements We would like to acknowledge Maheen Fazal for support in manuscript editing and its electronic submission.

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Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

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Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

Ethics approval The study was approved by the Ethical Review Committee of the National Institute of Cardiovascular Diseases (NICVD) (Ref #ERC-78/2021).

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available on reasonable request.

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Supplemental Material

Appendix

APPENDIX 1

Anaesthesia setup and training of anaesthesiologists in the Sindh province of Pakistan

In Pakistan health care supported by the government is stratified at three levels. The primary health care comprises of basic health care units (BHU) and rural health care centres (RHC). (Role of RHC) Secondary care is delivered at tehsil headquarter hospitals (THQ) (called Taluka hospitals in Sindh province) and District headquarter hospitals. These hospitals provide both acute ambulatory and inpatient services. The third tier are the tertiary care hospitals which are located in major cities. The government hospitals are supported by a private health care system. Due to the gaps in provision of health care services a large segment of the population relies on private medical facilities which range from clinics and small hospitals to teaching institutions.

The bodies responsible for post graduate training are the College of Physicians and Surgeons of Pakistan with various faculties. They award two types of diplomas in anaesthesiology, the fellowship FCPS which requires 4 years of structured training and MCPS that needs 2 years of training. In addition, some universities also award a diploma in Anaesthesiology after a two-year training program (DA). More recently some institutions have started offering a five-year Master of Science (MS) in anaesthesia. Government hospitals offer 2 type of staff positions, the academic posts and the non-academic posts with service commitment. Registration authority is PMC.

The following type of anaesthesia positions exist in Sindh.

- Specialist anaesthesiologist someone who possesses either MCPS/Diploma in anaesthesia and a 3 years' work experience (includes residency)
- Non-specialist Grade: These include both medical officers appointed in anaesthesia departments as well as Assistant anaesthesiologists

APPENDIX 2: SURVEY TOOL

ANAESTHESIA WORFORCE AT DISTRICT LEVEL IN SINDH PROVINCE OF PAKISTAN

Date of data collection (dd/mm/yy): _____

Healthcare facility name: _____

Healthcare facility region/district: _____

DEFINITIONS:

Physician (specialist) anaesthesiologist: A graduate of medical school who has completed a nationally recognized specialist anaesthesia training program/residency. (FCPS,MCPS,DA,Others)

Non-specialist physician anaesthetist: A graduate of medical school who has not completed a specialist training program/residency in anaesthesia but has undergone some formal anaesthesia training.

Anaesthesia Technician: An anesthetic technician is an allied healthcare worker who performs a patient care role predominantly assisting with the administration and monitoring of anaesthesia and has an extensive knowledge of anesthesia techniques, instruments, supplies and technology.

Operating Rooms (OR)

How many operating theatres/rooms does this health facility have?

(This includes operating theatres in the main operating theatre complex as well as remote theatres like obstetrics/gyn, accident & emergency, orthopaedics,)

Total number of ORs: _____

Anaesthesia services no	Full Time no	Part time
_____	_____	_____

- Physician (specialist) anaesthesiologists

- Non-specialist physician anaesthetists
- Other anaesthesia providers
- Anaesthesia Technicians

Do physician anaesthesiologist **trainees** work at this facility as part of their training?

If yes how many, provide numbers: _____

Surgical services	Full Time no	Part time no
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-
- Physician surgeons
 - General (non-specialist)
physicians who provide surgery

Obstetrics/gynaecology services	Full Time no	Part time no
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Obstetrician/gynaecologists (physicians)

General doctors who perform C-sections

COMMENTS

Supplemental Material File

TABLES

Supplementary Table 1 Distribution of operating rooms, anaesthesiologists, anaesthesia technicians, specialist surgeons, and obstetricians in the seven division of Sindh province

Regions	No. of hospitals		No. of operating rooms (OR)		Specialist anaesthesiologist		Anaesthesia technicians		Specialist surgeons		Specialist Obstetricians	
		%		%		%		%		%		%
Overall	90		201		125		67		221		178	
DIVISIONS												
Banbhore	15	16.7	18	9.0	9	7.2	7	10.4	4	1.8	11	6.2
Hyderabad	27	30.0	34	16.9	22	17.6	7	10.4	26	11.8	42	23.6
Karachi	13	14.4	41	20.4	36	28.8	10	14.9	54	24.4	54	30.3
Sukkur	8	8.9	39	19.4	29	23.2	23	34.3	70	31.7	30	16.9
Larkana	8	8.9	36	17.9	8	6.4	11	16.4	52	23.5	27	15.2
Mirpur Khas Shaheed	8	8.9	14	7.0	9	7.2	0	0.0	7	3.2	7	3.9
Benazirabad	11	12.2	19	9.5	12	9.6	9	13.4	8	3.6	7	3.9

Supplementary Table 2 Number of hospitals, operating rooms (OR), and anaesthesia workforce in districts of Sindh province.

Divisions and districts, Sindh province		No. of hospitals	No. of operating rooms (OR)	Specialist anaesthesiologists		Non-specialist anaesthetists		Other anaesthesia providers	
				FT	PT	FT	PT	FT	PT
DIVISIONS (7)	DISTRICTS (29)	90	201	125	6	54	0	7	0
Banbhore	Badin	6	11	7	4	2	0	0	0
	Sujawal	5	1	0	0	0	0	0	0
	Thatta	4	6	2	2	2	0	0	0
Hyderabad	Dadu	8	5	4	0	2	0	0	0
	Hyderabad	6	9	6	0	1	0	0	0
	Jamshoro	4	12	7	0	2	0	0	0
	Matiari	4	3	3	0	0	0	0	0
	Tando Allahyar	1	2	0	0	1	0	0	0
	Tando Muhammad Khan	4	3	2	0	0	0	0	0
Karachi	Malir	3	7	5	0	0	0	0	0
	Korangi	2	12	8	0	0	0	0	0
	East	2	0	0	0	0	0	0	0
	West	2	11	12	0	3	0	0	0
	Central	3	9	9	0	4	0	0	0
	South	1	2	2	0	0	0	0	0
Sukkur	Ghotki	3	5	3	0	2	0	0	0
	Khairpur	2	25	19	0	3	0	0	0
	Sukkur	3	9	7	0	0	0	5	0
Larkana	Jacobabad	2	5	1	0	4	0	1	0
	Kashmoor	1	0	0	0	0	0	0	0
	Larkana	1	25	3	0	16	0	0	0
	Qamber Shahdadkot	1	0	1	0	0	0	0	0
	Shikarpur	3	6	3	0	3	0	0	0
Mirpur Khas	Tharparkar	5	8	7	0	0	0	0	0
	Mirpur Khas	2	5	2	0	2	0	0	0
	Umerkot	1	1	0	0	0	0	0	0
Shaheed Benazirabad	Naushahro Feroze	3	7	3	0	2	0	0	0
	Benazirabad	4	4	4	0	1	0	0	0
	Sanghar	4	8	5	0	4	0	1	0