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Tablet e-Logbooks: Four Thousand Clinical Cases and Complications e-Logged by 14 Nondoctor Anesthesia Providers in Nepal

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BACKGROUND: To meet the need for essential surgery across rural Nepal, anesthesia at district level is delivered by nondoctor anesthetists. They require support to maintain confidence and competence, and upgraded professional registration to secure their status. To meet these needs, a distance-blended learning course was pioneered and delivered. A core course requirement was to log all clinical cases; these were logged on a new e-logbook.

METHODS: Fourteen nondoctor anesthesia providers working in 12 different districts across Nepal were enrolled in the 1-year course. The course is based on self-completion on a tablet loaded with new learning modules, a resource library, and a case logbook. Continuous educational mentoring was provided by anesthesiologists by phone and email. The logbook included preanesthesia assessment and interventions, American Society of Anesthesiologists (ASA) grading, types of cases and anesthesia given, monitors used, complications, outcomes and free text remarks. Cases were uploaded monthly to a database, and mentors reviewed all logbook entries.

RESULTS: The 14 nondoctor anesthesia providers were widely distributed across the country in district, zonal, community, and mission hospitals, and had different levels of clinical experience and caseloads. Logbooks and uploads were regularly completed without difficulty; 1% cases were entered incompletely with no case details provided. A total of 4143 cases were recorded. Annual caseload per nondoctor anesthesia provider ranged from 50 to 788, the majority of which were under spinal anesthesia; 34% of the total cases were cesarean deliveries, of which 99% received spinal anesthesia. Fifty gastrointestinal laparotomies (1% total) were recorded. Ninety-one percent of cases were ASA I, 0.8% ASA III/IV. Pulse oximetry was used in 98% of cases. Complications were recorded in 6% of cases; the most common were circulation problems (69%) including hypotension and occasional bradycardia after spinal anesthesia. Airway complications were usually under ketamine anesthesia requiring basic airway maneuvers; 4 difficult intubations were recorded under general anesthesia. Anesthesia outcomes were good with overall mortality of 0.1% (total 4 cases). Causes of death included severe preeclampsia, sepsis postlaparotomy, and patients with multiorgan failure for minor procedure.

CONCLUSIONS: The tablet-based electronic anesthesia logbook was successfully used to record cases, complications, and outcomes across rural Nepal. The nondoctor anesthesia providers had trust and confidence in recording outcomes. It remains to be tested whether an e-logbook would be routinely completed outside of a specific training course. Such a logbook could be incorporated into all continuous professional development programs for rural nondoctor anesthetists. (Anesth Analg 2017;125:1337–41)

Nepal is a landlocked, low-income mountainous country with a population of approximately 27 million. Despite improvements in medical facilities, even in remote areas, there is a large unmet surgical burden at the district level across the country. This is due to low availability of essential surgical services especially lack of trained health professionals.[1] There are currently no anesthesia doctors working at the rural district level and very few at the zonal level.[2]

To meet the need for comprehensive essential obstetric care and essential surgery across rural Nepal, the Nepal Government sanctions, and supports, delivery of anesthesia at district level by nondoctor anesthesia providers (called anesthesia assistants [AAs]); from 2002 until 2011, 94 AAs were trained in a 6-month preservice program. These AAs are trained in the designated hospital by qualified physician anesthesiologists with experience in training AAs. To enroll in the course, the participant should be either a staff nurse or health assistant (highest academic degree for paramedics). From 2012, there is now a 12-month training program in active service across the country, delivered by National Academy of Medical Sciences, a Government University. There are 14 to 20 participants trained every year. There remain forty-six 6-month trained AAs working actively across Nepal.[3] They require support to maintain confidence and competence, and to secure their status,

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upgraded professional registration to equal that of the current 12-month trained AAs.

To meet these needs, as part of a wider AA continuing professional development program, an innovative, competency-based, year-long, distance-blended learning course was developed by international and national anesthesiologists with experience in training AAs. Software and financial support were provided by Nick Simons Institute. The course was approved by the Government of Nepal's National Health Training Center (NHTC) and conducted on their behalf in 2014–2015. The course includes a refresher course of 5 days, 1 year with tablet-based self-learning modules and clinical case logs, regular educational mentor communication, a midcourse 2-week contact time at an AA training site, regular text messaging, and ends with clinical and multiple choice question (MCQ) examinations. A core course requirement was to log all clinical anesthetic cases performed by the participants. No nondoctor anesthesia providers outside training programs were recording clinical cases,[2] none were using an e-logbook, and none were recording complications. Beyond basic categorization, there is also no consistent recording of anesthesia at district level across Nepal in operating theater record books.[2] We report the efficacy of tablet e-logbooks and case distribution, severity, interventions, complications, and outcomes.

METHODS

The Anesthesia Assistant Upgrade (AAU) blended learning course, designed to upgrade nondoctor 6-month trained AAs, was developed over 18 months by a team of Nepali and overseas physician anesthesiologists (from Southampton and Australia) who are experienced in AA training, working in collaboration with the Nick Simons Institute in the development of the AAs to improve the surgical services in rural Nepal. All of them are consultant (specialist) physician anesthesiologists with at least 1 year of experience in teaching and training AAs. Regular educational mentor phone communication was based on course case study discussion and the difficult cases participants had recorded. Regular text messaging focused on educational content reminders (eg, preoperative preparation), and course requirement reminders to complete the monthly module. This helped to summarize important learning points and reinforce the completion of the modules.

Tablets were used as the primary educational platform, owing to ease of use and lack of reliable Internet access in most parts of the country for these workers. Tablet content included 168 new case studies, pre- and posttests, video lectures, matching exercises, and a resource library. All module work and logged clinical cases were uploaded centrally, where clinical mentors were able to review work.

The new e-logbook was developed after review of nondoctor anesthesia providers' caseload and experience,[2] followed by discussion and consultation with Nepali anesthesiologists (AA trainers). Key goals were to enable easy confident logging of cases, recording of simple preoperative interventions and core anesthetic information about each case and complications.

The logbook included preanesthesia assessment and interventions, American Society of Anesthesiologists (ASA) scoring, anesthesia provided, complications divided into airway, breathing, circulation and others, outcome (mortality in the operation theater or at 24 hours), and free text remarks (Table 1).

The tablet used was an Acer model B1-710 at a cost of $200 each. The total course cost was $32,800 and included tablets ($2800), software development ($7000), and mentors payment, and other logistics ($23,000); all of these costs were financed by the Nick Simons Institute.

The logbook was preloaded onto the tablet along with all course modules and resources. To familiarize participants with tablet e-logbook entry, practice dummy cases were entered on the logbook with supervision during the refresher course.

Cases were uploaded monthly to a central database and mentors reviewed all logbook entries for educational discussion with participant nondoctor anesthesia providers. All data were subsequently entered and analyzed using Microsoft Excel.

The Nepal Government's National Health Training Center ratified and approved the course; it was developed and run by the Nick Simons Institute, Kathmandu, Nepal. The course was run from April 2014 to April 2015.

RESULTS

Fourteen AAs working in 12 different districts were enrolled on the 1-year course. They were all fully qualified and experienced staff nurses or health assistants (the highest paramedical cadre) and had already trained in anesthesia on the 6-month program and all were actively providing anesthesia in remote places in Nepal. Thirteen successfully completed the whole course including the final examination. Fourteen completed all e-modules, but 1 participant dropped out before the examination because she was transferred to a different hospital where there was no surgical facility available.

A total of 4143 cases were e-logged by the 14 AAs. Data entry proved straightforward and uploads were regularly completed without difficulty. Only 1% cases were entered incompletely with no details about the cases. Tablet problems were rare and included battery backup failure and a locked tablet in one case.

Case Distribution

Annual caseload ranged from 50 to 788 per AA and the majority of cases were done under spinal anesthesia. Very

Table 1. Logbook Categories With Choices

Categories
Date, hospital number, sex, age
Was a preanesthetic checkup (PAC) done?Resuscitation intervention (oxygen, antibiotics, blood)
ASA grading
Operation hours: emergency
Anesthetic given, case description
Monitoring, inspired O_2, pulse oximetry, $ETCO_2$, ECG, NIBP
Complications ABCDE (detail in remarks)
Patient outcome, cesarean delivery outcome (newborn outcome)
Surgeon, AA supervision
Remarks

Abbreviations: AA, anesthesia assistants; ECG, electrocardiogram; NIBP, noninvasive blood pressure.

Table 2. Overall Case Distribution

Type of Cases	Total No.	Emergency	Elective	Type of Anesthesia			
				GA	SAB	Ketamine	LA
Cesarean delivery	1426	1110	316	18	1367		
Ortho minor	512	138	374	56	48	246	159
Ortho major	305	59	246	82	159	18	45
Hernia/hydrocele/anal procedures	281	27	254	47	216	17	
Appendectomy	213	213		53	142		
Cholecystectomy	166		166	166			
I&D, debridement	153	53	100	5	14	126	8
Vaginal hysterectomy	111		111		109		
Laceration/burn	105	28	77	16	27	47	15
Total abdominal hysterectomy	98		98	28	67		
Obstetric other	81	48	33	3	17	58	2
Laparotomy (GI)	69	58	11	55	13		
Laparotomy (gynecologic)	46	32	14	20	24		
GU stones	31		31	23	8		
Other	546	123	423	135	132	200	78
Total	4143	1889	2254	707	2343	712	307

Abbreviations: GA, general anesthesia; GI, gastrointestinal; GU, genitourinary; I&D, incision and drainage; LA, local anesthesia; Ortho, orthopedic; SAB, subarachnoid block.

Table 3. Ratio of Cesarean Delivery to Different Major Cases

Cases	Numbers	Ratio
Cesarean delivery/total cases	1426/4143	0.34:1
Cesarean delivery/GI laparotomy	1426/69	20.6:1
Cesarean delivery/gyne laparotomy	1426/46	31:1
Cesarean delivery/cholecystectomy	1426/166	8.5:1
Cesarean delivery/hysterectomy	1426/209	6.8:1

Abbreviations: GI, gastrointestinal; gyne, gynecologic.

Table 4. Monitoring Used During Intraoperative Period

Monitors	Yes	No	Not Specified	% Used
Pulse oximetry	4058	49	36	98
BP (NIBP)	3710	420	36	89
ECG	2836	1271	36	68
Capnography	85	4022	36	0.02

Abbreviations: BP, blood pressure; ECG, electrocardiogram; NIBP, noninvasive blood pressure.

low caseloads were seen at hospitals in the region with the most remote districts, the Far-West region, and the highest caseloads were recorded at a mission hospital in Western Nepal. Caseloads did not reflect the only anesthesia at a given hospital, unless the nondoctor anesthesia provider worked solo at that institution.

Thirty-four percent of the total cases were cesarean deliveries, of which 99% received spinal anesthesia. The second most common emergency was appendectomy (11% of total emergencies); the majority (75%) was done under spinal anesthesia, although 11% of these needed extra sedation (Table 2).

Fifty-eight gastrointestinal laparotomies (1% of total cases) were recorded. Orthopedic cases were divided into minor, such as closed reduction of fractures, and major, such as open reduction of fractures. The ratio of cesarean deliveries to other major surgeries may suggest an inadequately met surgical need in these rural areas (Table 3).

Preoperative Status and Interventions

Ninety-one percent of cases were ASA I, 8% were ASA II, and 0.8% were ASA III and IV. This may be a true reflection of cases or reflect limitations or inexperience with ASA classification.

Preoperative interventions including oxygen, fluids, and blood administration were recorded in 0.1% of cases. This low number reflects the healthy status of most patients or the fact that, in Nepal, preoperative resuscitation is the responsibility of the general practitioner or the surgeon, not the AA.

Anesthesia Delivered

The majority of cases were done under spinal anesthesia; 17% were under general anesthesia (GA) (Table 2).

Monitoring

Pulse oximetry is generally available in surgical facilities and was used in 98% cases (Table 4).

Complications and Outcomes

Complications were recorded in 6% of the cases; the most common were circulation problems (69%) including hypotension easily treated with a vasoconstrictor and occasional bradycardia after spinal anesthesia. Airway complications included airway obstruction, seen mostly with ketamine anesthesia and relieved by simple airway maneuvers. Four cases of difficult intubation were recorded for which a bougie was used to intubate. Breathing problems noted were complaints of breathing difficulty under spinal anesthesia, but the exact levels of spinal anesthesia in these cases were not recorded. They were easily treated with supplemental oxygen. Drug problems recorded included patchy spinal anesthesia requiring ketamine supplementation, repeat spinal anesthesia, or conversion to GA. Other problems included difficult IV cannulation in burns, intraoperative blood loss, supraventricular tachycardia needing adenosine, delayed recovery after GA, and vomiting under spinal anesthesia. An example of an equipment problem was a displaced laryngeal mask airway (Table 5).

There were no recorded anesthesia-related deaths and overall outcomes were good. Perioperative mortality was

Table 5. Complications

Complications	No.	Type of Anesthesia			
		Ketamine	GA	Spinal	Others
None	3820				
Airway	35	16	15	3 (after ketamine)	1
Breathing	38	12	5	20	1
Circulation	199	7	29	158	5
Drugs	13	1	1	6 (failed/patchy)	1
Equipment	2		2		
Other	36	2	3	30	1

Abbreviation: GA, general anesthesia.

0.1%, a total of 4 cases: one from severe preeclampsia, one from postoperative sepsis after laparotomy for intestinal perforation, one from tuberculous empyema with multiorgan failure after chest drain insertion, and one from alcoholic liver disease with multiorgan failure after abscess incision and drainage under sedation.

DISCUSSION

e-logbooks were successfully used as part of a blended learning continuous professional development course across Nepal with 14 nondoctor anesthesia providers. This is the first time e-logbooks have been completed for district health workers in Nepal and may be the largest number of anesthetic cases e-logged by nondoctor providers anywhere globally. The AAs felt confident enough to record their cases, complications were routinely documented, and outcomes were good.

Shortage of health workers remains a key limitation in the delivery of safe obstetric care in hospitals in rural Nepal. To meet the demand, task shifting or sharing has been endorsed by the World Health Organization, taken up by the Government of Nepal,[3] and more recently by the Lancet Commission on Global Surgery.[4] This remains controversial, and a recent systematic review on anesthetic maternal mortality states that nondoctor anesthetic-related mortality is twice that for doctors[5]; however, this cannot be disaggregated for location, severity, or lateness of presentation to name but 3 contributing factors. Our data suggest that anesthesia-related mortality for obstetric care is very low for this group of AAs working in rural Nepal. This may reflect competence and support, or timely presentations of less sick patients, enabling the provision of spinal anesthesia, which may be safer than GA in this circumstance. In the continued absence of adequate institutional detailed perioperative data, corroboration of data entry remains impossible.

It is generally agreed that providing support for rural health workers is essential to upgrade and maintain anesthesia skill and safety.[6] How best to do this has been widely discussed.[6–9] Options include refresher courses, e-learning, and new models combining both such as our distance blended learning courses. Rigorous efficacy data are lacking for any of these approaches. We believe that logbook entry, analysis, and discussion with educational mentors may be an efficacious approach.

Working nondoctor anesthesia providers were able to complete the e-logbooks including preoperative interventions and complications. This gives a much more complete picture of anesthesia delivery and safety, and provides a baseline on which to build successful rural anesthesia delivery and educational interventions. Following the first course reported here, a second AAU is nearing completion in early 2017, and the aim for this model of blended learning is to be incorporated into national AAU continuous professional development programs pending cost analysis and Government of Nepal approval. Current AA continuous professional development is only the follow-up and enhancement (FEP) program: a day of assessment and coaching delivered at their own hospital once only after training.[2]

AAs are a vulnerable health worker group providing anesthesia service in rural Nepal with little educational support, and recording of cases shows their confidence in a government-ratified educational program run for them. Recording of their own cases throughout the course provided an educational opportunity for self-evaluation, tying in with course content, and enhancing mentor-AA educational relationships. Logbook data gaps or educational points highlighted by the AAU such as spinal level, ASA, and preanesthesia assessment are already in ongoing AA educational programs, but the robust data from the AAU provides further impetus to emphasize such teaching.

Analysis of cases provides vital insight into anesthesia work at district level in Nepal. It lends support for the work of these AAs as providers of safe anesthesia in difficult circumstances. The information obtained will assist health care planners to reduce the gap in provision of surgical services in rural Nepal. Anesthesia educators should be encouraged to develop and provide targeted, appropriate continuing medical education programs. We believe the logbook was successful because it was based on the experience of the end users, consistent with international standards, involved a simple-to-use tablet logbook system, had strong educational mentoring, central coordination and encouragement, and a motivated group of participants. A limitation was the unavailability of fast Internet services in remote places of the country for daily uploads. A mobile phone application would facilitate contemporaneous data entry.

A tablet-based electronic anesthesia logbook was successfully used to record cases, complications, and outcomes across rural Nepal. The AAs had trust and confidence in recording outcomes, which were very good. It remains to be tested whether an e-logbook would be routinely completed outside a specific training course. Such a logbook should be incorporated into all continuous professional development programs and anesthesia safety analysis for rural anesthetists.

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DISCLOSURES

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