







BMJ Open Vacuum births and barriers to its use: An observational study in governmental hospitals in Sierra Leone

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ABSTRACT

Objectives Assisted vaginal births (AVD) can prevent unnecessary caesarean sections (CS). The number of CS is increasing rapidly in sub-Saharan Africa; these are still associated with high perioperative mortality rates. The aim of this study is to define the proportion of AVD in governmental hospitals in Sierra Leone and examine barriers to its use.

Design Retrospective observational study of AVD between September 2016 and August 2017.

Setting A representative selection of Sierra Leonean governmental hospitals (n=11).

Participant and intervention (a) Data were collected from labour ward records. (b) Health workers involved in labour management were questioned.

Primary and secondary outcome measures (a) Number of spontaneous, assisted vaginal and caesarean births. (b) Potential barriers to use vacuum-assisted births.

Results (a) Total annual numbers of registered births, AVD and CS were 16 833, 631 (3.7%) and 4642 (27.6%). The proportion of vacuum births ranged from 0.0% to 5.1% across facilities. The proportion of CS ranged from 6.5% to 33.4%. (b) The most frequently reported reasons for limited vacuum use were lack of equipment (25/72; 35%) and insufficient training (18/72; 25%).

Conclusions The proportion of AVD was particularly low in district facilities, and according to healthcare workers this was mostly due to lack of equipment and insufficient training. Implementing relevant training programmes on the use of vacuum devices and increasing the availability of working devices may increase the proportion of vacuum births in government hospitals in Sierra Leone. This could reduce the number of unnecessary CS.

BACKGROUND

When used for appropriate indications, assisted vaginal births (AVD) can reduce the number of unnecessary caesarean sections (CS) and their associated risks.^{1–3} AVD involve using vacuum or forceps devices; they may be indicated for either maternal or fetal reasons in the second stage of labour. Only skilled providers can safely undertake these procedures. WHO recommends that vacuum births are performed by either specialised or

STRENGTH AND LIMITATIONS TO THIS STUDY

- ⇒ The study had broad coverage, including all Sierra Leone's regional hospitals and half of its district hospitals involved in emergency obstetric care.
- ⇒ Answers to the questionnaire are likely to be representative for associate clinicians and midwives because the participation was close to 50% for both groups. Inclusion rate for doctors was low and their answers should therefore be interpreted with caution.
- ⇒ An important limitation is that our study only describes births in governmental hospitals, excluding other health facilities.
- ⇒ Another limitation was that the labour ward registers were not quality controlled. In several hospitals, information about births were documented retrospectively and not necessarily by the person involved, creating a potential recall bias.

non-specialised medical doctors or advanced-level associate clinicians or midwives.⁴

Institutional rates of AVD in several sub-Saharan African countries have been reported at approximately 1%.^{1–5} In a study assessing AVD rates in European countries, rates varied from 0.5% to 16.4%.⁶ Ratio of CS to AVD (CS/AVD ratio) has been suggested as a better measure of the differences in interventions; this measure facilitates comparisons between countries.¹ A high ratio may suggest that AVD are underused and that some CS could have been prevented. A low ratio may suggest an underutilisation of CS. However, the ideal CS/AVD ratio has not been established.

Earlier studies in low-resource settings have indicated that lack of skilled operators and functional equipment is an obstacle for performing AVD.⁷

For many years, Sierra Leone has had one of the highest maternal mortality ratios (MMR) in the world.⁸ Despite the global reduction in the last 25 years, the proposed Sustainable Development Goal 3, with an aim

to reduce MMR worldwide to no more than 140 per 100 000 live births by 2030, it is still a long way off.^{8–11} The crude birth rate in Sierra Leone is 30.¹² Based on the total population numbers from 2016, the number of births is approximately 220 000.¹³ The percentage of births in health facilities has increased to 83%, with 98% of these taking place in public health facilities.¹² The number of CS in Sierra Leone is increasing, with a relative increase of 35%—from 2.1% to 2.9% of all live births from 2012 to 2016.¹⁴ These numbers are still far below the 10%–15% WHO recommends.¹⁵

In 2011, CapaCare partnered with the Sierra Leonean government to launch a surgical training programme for non-specialised medical doctors and associate clinicians (the latter with 3 years of pregraduate medical training with at least 2 years of clinical experience before they complete another 3 years postgraduate training in emergency obstetrics and surgery) to mitigate the shortage of qualified personnel and improve access to training in order to safely manage surgical and obstetrical emergencies, including vacuum births.¹⁶ Similar programmes have been initiated in other countries.^{17 18} Reintroducing vacuum extraction in low-income and middle-income countries has been proposed as an effective way to reduce unnecessary CS and prevent morbidity and mortality related to prolonged labour and/or surgical or anaesthetic complications of CS.^{2 3 19}

Therefore, objectives of this study are to estimate the proportion of AVD in a representative selection of governmental hospitals in both rural and urban Sierra Leone and assess potential barriers to perform AVD.

METHODS

This study consists of two parts, (a) and (b). Part (a) is a quantitative retrospective observational study based on labour ward records from a sample of governmental hospitals in Sierra Leone for the period between September 2016 and August 2017. Part (b) is a survey among health practitioners involved in labour management, to assess the use of vacuum devices and barriers to their use. Participants answered the survey in September or October 2017.

We collected data from 11 of the 18 governmental hospitals providing emergency obstetrics including CS. We included Sierra Leone's only tertiary referral hospital and all three regional referral hospitals. Of the 14 district hospitals, 7 were randomly selected (figure 1). All agreed to participate.

Hospital visits were conducted between September and October 2017 by two local associate clinicians (TF and IS) enrolled in the CapaCare surgical training programme, along with two Norwegian medical students (EB and EØ).¹⁶

For part (a), monthly numbers of spontaneous vaginal births, AVD and CS registered over the study period were collected. Indications for vacuum births were not documented and indications for CS were not documented

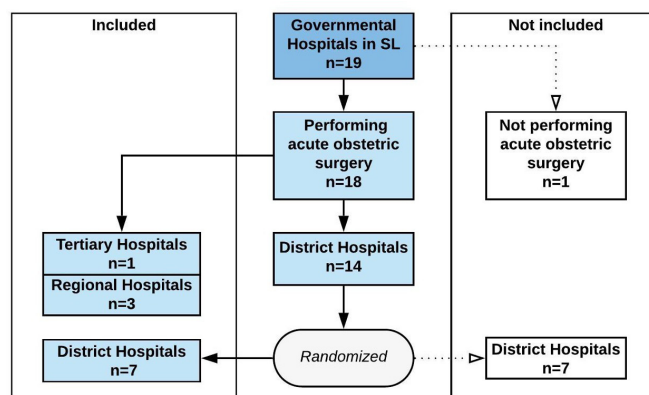


Figure 1 Flowchart for including hospitals.

systematically. For the annual number of births, AVD and CS, we calculated the median with IQR.

For part (b), we assessed health practitioners' experiences with and attitudes towards vacuum extraction, using a 21-item questionnaire (online supplemental material 1). The author group designed the questionnaire, which was adapted after a pilot run prior to the study. The pilot was completed by a local medical doctor, a local associate clinician and a midwife. The variables consisted of 12 multiple-choice questions with up to eight alternatives, as well as eight closed and one open question.

All health workers who were present on the day of our visit, were involved in labour management and authorised to perform vacuum extractions, were eligible to answer the questionnaire. After providing written consent, the participants were introduced by either a chief medical doctor or the head nurse of the obstetrics and gynaecology department. Participants completed the questionnaire without supervision, with the investigators available for questions.

We used Microsoft Excel V.16.11 and SPSS V.24 to perform descriptive analysis of the data, calculate rates for assisted vaginal and caesarean births and determine the median with IQR for the annual numbers of spontaneous births, AVD and CS in the different hospitals. The CS/AVD ratio was also calculated.¹

Patient and public involvement

The idea of the study was conceived by the last author, while training Sierra Leonean health professionals in the use of vacuum devices. The health personnel themselves, who were trainee associated clinicians and midwives, pointed out that there were very few vacuum extractions performed compared with CS. Informal discussions for possible reasons for this and ideas for improvements were held during educational courses with the health personnel. These discussions inspired the authors to compile the questionnaire in unison. The questionnaire was subsequently given to one associate clinician, one midwife and one medical doctor to be completed and for comments, as a pilot. Some questions were altered according to their suggestions. Patients were not involved

Table 1 Numbers and mode of birth per type of governmental hospital from September 2016 to August 2017

	Tertiary hospital		Regional hospitals		District hospitals		Total	
	n=1		n=3		n=7		n=11	
	n	%	n	%	n	%	n	%
Total number of births	6439	100	5485	100	4909	100	16 833	100
Caesarean sections	2028	31.5	1509	27.5	1105	22.5	4642	27.6
Assisted vaginal births	327	5.1	167	3.0	137	2.8	631	3.7
Spontaneous vaginal births	4084	63.4	3809	69.4	3667	74.7	11 560	68.7

in this study because it concerns health practitioners as subjects.

RESULTS

(a) The total annual numbers of registered births, AVD and CS were 16 833, 631 (3.7%) and 4642 (27.6%), respectively (table 1).

CS rates ranged from 21.4% to 33.4% in the regional hospitals and 6.5% to 31.5% in the district hospitals. The median CS rate was 25.7% (IQR 16.5–31.5). The proportion of AVD ranged from 0.0% in two district hospitals to 5.1% (n=327) in the tertiary hospital. The median rate of AVD was 2.8% (IQR 1.6–4.2). The total assisted birth rate (AVD+CS) in the participating hospitals was 31.3%. The CS/AVD ratio was 7.4, with a median of 7.8 (IQR 6.6–11.9). Two hospitals did not perform AVD but were still included in the calculations of median (IQR) by inserting 0.001 in the denominator to illustrate zero AVD. Forceps was not used in any of the participating hospitals.

(b) Of the 188 eligible health practitioners, 72 (38.3%) answered the questionnaire (table 2). Out of the eligible health practitioners, 6 (13.3%) of the doctors, 11 (47.8%) of the associate clinicians and 55 (45.8%) of the midwives participated. Not all participants answered every question, and one health practitioner did not report profession. Reasons for non-participation were not systematically mapped.

Medical doctors (n=6) reported a median of 4.0 (IQR 0.8–31.3) vacuum extractions performed during the past year, while the median for associate clinicians (n=11) was 10 (IQR 5.0–15.0). The median for midwives (n=46) was 5 (IQR 0.0–10.0).

The most common reason for not using vacuum extraction was lack of available devices (34.7%); this was

similar across the three professions (table 3). A high proportion of medical doctors (33.3%) and midwives (29.1%) reported ‘not enough training’ as a limiting factor, while none of the associate clinicians did.

Nearly all participants (n=68, 94.4%) would use vacuum extraction more frequently if they received more training. When asked if better availability of functional vacuum equipment would lead to more frequent use, n=63 (87.5%) answered ‘yes’. Confidence in finding a correct indication (n=57, 81.9%) was similar to confidence in performing vacuum extraction among all participants (n=57, 79.2%), with only minor differences between the professions. The Kiwi cup, followed by the rubber cup, was the preferred type of vacuum extractor among associate clinicians and midwives. The three doctors who answered this question had no clear preference.

DISCUSSION

Rates of vacuum-assisted births were higher in the regional hospitals than the district hospitals. Two out of seven district hospitals did not perform any vacuum-assisted births. These hospitals were without associate clinicians from the CapaCare surgical training programme. Overall, 10 out of 11 associate clinicians were participating in or had completed the surgical training programme, which includes training to use vacuum devices.¹⁶ This may have been the reason that associate clinicians performed more than two times as many vacuum-assisted births compared with doctors and midwives and underlines the importance of training. A high proportion of medical doctors (33.3%) and midwives (29.1%) reported ‘not enough training’ as a limiting factor, while none of the associate clinicians did so. From 2011 to 2016, 48 trainees enrolled in the CapaCare training programme and only two of

Table 2 Total number of eligible staff and participants

	Tertiary hospital		Regional hospital		District hospitals		Total	
	Participants, n (%)	Eligible staff	Participants, n (%)	Eligible staff	Participants, n (%)	Eligible staff	Participants, n (%)	Eligible staff
MD	1 (3.6)	28	1 (20.0)	5	4 (33.3)	12	6 (13.3)	45
AC	2 (25.0)	8	5 (71.4)	7	4 (50.0)	8	11 (47.8)	23
Midwives	8 (24.2)	33	18 (50.0)	36	29 (56.9)	51	55 (45.8)	120

AC, associate clinician; MD, medical doctor.

Table 3 Availability, preference and limiting factors for use of vacuum devices

		MD n=6 (%)		AC n=11 (%)		Midwives n=55 (%)		Total n=72 (%)	
What type of vacuum device is available at your labour ward?	Metal cup	6	(100)	6	(55)	29	(53)	41	(57)
	Rubber cup	3	(50)	7	(64)	32	(58)	42	(58)
	Kiwi cup	3	(50)	11	(100)	27	(49)	41	(57)
	Not sure	0	(0)	0	(0)	2	(4)	2	(3)
	Not answered	0	(0)	0	(0)	5	(9)	5	(7)
Which vacuum device have you used?	Metal cup	5	(83)	7	(64)	24	(44)	36	(50)
	Rubber cup	3	(50)	10	(91)	28	(51)	41	(57)
	Kiwi cup	2	(33)	11	(100)	28	(51)	41	(57)
	Not answered	0	(0)	0	(0)	9	(16)	9	(13)
This instrument is currently in a functional state in the hospital you are currently working in	Metal cup	5	(83)	5	(45)	23	(42)	33	(46)
	Rubber cup	2	(33)	5	(45)	25	(45)	32	(44)
	Kiwi cup	1	(17)	9	(82)	21	(38)	31	(43)
	Other	0	(0)	0	(0)	2	(4)	2	(3)
	Not answered	1	(17)	0	(0)	9	(16)	10	(14)
Which vacuum device do you prefer?	Metal cup	1	(17)	0	(0)	6	(11)	7	(10)
	Rubber cup	0	(0)	2	(18)	18	(33)	20	(28)
	Kiwi cup	0	(0)	10	(91)	25	(45)	35	(49)
	Depends on the situation	2	(33)	1	(9)	6	(11)	9	(13)
	Not answered	3	(50)	0	(0)	7	(13)	10	(14)
What is limiting your use of vacuum?	Not enough training	2	(33)	0	(0)	16	(29)	18	(25)
	Not enough experience	2	(33)	0	(0)	8	(15)	10	(14)
	Not sure about indications	0	(0)	0	(0)	3	(5)	3	(4)
	Device is not working	2	(33)	5	(45)	5	(9)	12	(17)
	Not available	3	(50)	7	(64)	15	(27)	25	(35)
	Mothers do not like it	0	(0)	2	(18)	4	(7)	6	(8)
	Too painful to insert	0	(0)	0	(0)	2	(4)	2	(3)
	Worried about injury to baby	0	(0)	0	(0)	6	(11)	6	(8)
Not answered	0	(0)	0	(0)	15	(27)	15	(21)	

AC, Associate clinician; MD, Medical Doctor.

them were medical doctors, which makes it unlikely that the doctors in this study have participated in the training programme.¹⁶ This may indicate gaps in education among doctors and midwives compared with associate clinicians and suggest that surgical training courses as introduced by CapaCare, could result in increased proportions of AVD.

The primary reasons for limited use of vacuum extraction align with findings from other studies.⁷ A rate of 2.4% was reported in a hospital-based study in Uganda.¹⁸ Institutionally based studies in countries comparable to Sierra Leone report rates of approximately 3%.^{20 21} Although these numbers are similar, the rate of vacuum-assisted births in this study is hospital-based and should be compared cautiously to rates found in other studies, which are primarily institutionally based.

Institutionally based numbers represent a heterogeneous sample of health facilities offering maternity care, including primary health facilities. A hospital-based study that excludes primary health facilities is more likely to overestimate total vacuum-assisted birth rates.

This study shows a high total assisted delivery rate (AVD+CS) in government hospitals (31.3%)—higher than national rates reported in recent studies in comparable countries.^{1 20 21}

This is one of the few studies using the CS/AVD ratio to interpret obstetrical practice in health facilities.²² The CS/AVD ratio is an indicator describing the balance between assisted vaginal deliveries and CS. A CS/AVD ratio of 7.4 was found for Sierra Leonean government hospitals: for 7.4 CS, one AVD was performed. Compared with some countries with higher CS rates such as Congo-Brazzaville

(CS/AVD ratio=27.4; AVD rate<0.1) and Ghana (CS/AVD ratio=22.0; AVD rate=0.5), the Sierra Leonean CS/AVD ratio is much lower.¹ A high CS/AVD ratio can be explained by underutilisation of AVD; it may indicate that some CS could have been prevented with AVD. The Sierra Leonean CS/AVD ratio is higher than the ratio found in the WHO Global Survey Africa (2.9), which can be explained by underutilisation of CS in the countries in that study.^{1 20} Comparable countries such as Senegal had a CS/AVD ratio similar to what we report in this study, but with lower rates of both AVD (0.5) and CS (4.4).¹

Our findings suggest that attempting to increase the proportion of vacuum births by merely raising awareness on vacuum births as alternative mode of birth may be insufficient. Poor availability of functional vacuum devices must also be addressed, as well as training of its use. A programme in Uganda focusing on developing a vacuum extraction guideline, as well as supplying equipment and training staff, succeeded to improve maternal and perinatal outcomes.¹⁸ In Tanzania, assistant medical officers were trained in comprehensive emergency obstetric care, with AVD taught as a key intervention, resulting in increased numbers of AVD and reduced numbers of CS.¹⁷

Strengths and limitations

The strength of our study is its broad coverage, including all Sierra Leone's regional hospitals and after random selection, half of its district hospitals involved in basic and comprehensive emergency obstetric and neonatal care. The overall participation rate was rather low for the health practitioners participating in this study, mainly because clinical activity was prioritised. Answers in the questionnaire are likely to be representative for associate clinicians and midwives, because their participation rate was close to 50% for both groups. Few doctors were available to complete the questionnaire, and their inclusion rate was very low. Selection bias cannot be ruled out and we can only speculate on the direction. In general, and specifically for the doctors, it seems unlikely that specifically proficient professionals would systematically not participate.

Another limitation is lack of quality control of labour ward registers. In several hospitals, information about births was documented in the register retrospectively, and not necessarily by the involved person, creating a potential recall bias. In some hospitals, the monthly overall statistics found in the birth registers did not correlate with the manual count from all registered births. We assume, however, that the manual counts performed by study members are reliable; these constitute a strength of the study.

When interpreting the rates of AVD and CS, it is important to keep in mind that our study only described births in government hospitals, excluding other health facilities. Population-based CS rates in Sierra Leone in 2016 have been reported at 2.9%.¹⁴ The exact population-based AVD rate is unknown, although a study that collected data in 2012 suggested a rate of <1%.²³

A further limitation is the internal validity of the questionnaire designed for the purpose of the study. We attempted to improve the validity by a pilot run involving all different types of healthcare workers. We, however, had one person from each group only.

CONCLUSION

The rate of AVD in 11 out of 18 governmental hospitals in Sierra Leone providing emergency obstetric care including CS was 3.7%; CS rate was 27.6%. The primary limiting factors for performing more vacuum extractions from the health practitioners' view were 'availability' and 'not enough training'. A large majority of the study participants answered that increasing the availability of functional vacuum equipment and providing training to use vacuum devices would increase its use. This suggests that implementing the use of vacuum devices within a training programme appears effective for associate clinicians and systematic implementation of similar training for medical doctors and midwives in their education should be considered. Availability of functional vacuum devices is a prerequisite. This is expected to be an important tool for preventing unnecessary CS and improving maternal and perinatal health in the country.

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Contributors RL-H conceived the study. EB, EØ, AvD, JW and HAB drafted the protocol. EB, EØ, TF and IS performed data collection. EB, EØ, AvD and RL-H performed data analysis. All authors were involved in interpretation of results. The manuscript was written by EB, EØ and RL-H and was refined by AvD, HAB and JW as well as approved by TF and IS. RL-H is the guarantor.

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Competing interests HAB, AvD and JW are unpaid board members of CapaCare, the NGO organising the surgical training programme. RL-H has participated as a trainer in the same programme. The authors declare no other competing interests.

Patient and public involvement Patients and/or the public were involved in the design, or conduct, or reporting, or dissemination plans of this research. Refer to the Methods section for further details.

Patient consent for publication Not applicable.

Ethics approval This study involves human participants. Ethical approval was obtained from the Sierra Leone Ethics and Scientific Review Committee and the Norwegian Regional Ethical Committee (2017/201). The approval date for the study was 25 May 2017. Participants gave informed consent to participate in the study before taking part.



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