

Factors affecting outcomes of bovine caesarean sections, with a focus on maternal survival to 14 days after surgery

Appendix 1:

Abrahamsen EJ. Chemical restraint in ruminants. *Vet Clin N Am-Food Anim Pract* 2008;24:227-243.

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Table S1: Table grouping of variables collected for the bovine caesarean section audit
(November 2013 to October 2015).

Questionnaire 1 – Day of Operation

Veterinarian and Veterinary Clinic

Practice Name	Veterinarian	Date of Surgery
Practice Size	Experience (y)	<i>Day of the Week</i>
Veterinary School		<i>Month of Surgery</i>
Affiliation		<i>Year of Surgery</i>
		Time of Day

Dam History

Unique client/ Farm name	Dystocia History - Sire	Attempt to Deliver – Farmer (min)
Dam Identification	Dystocia History - Dam	Attempt to Deliver – Vet (min)
Productive Type	Previous C-sections	Excessive Force
Lactation number - Categories	Elective	
X-Breed	Temperament	

Surgeon’s Initial Examination

No headway when pulling	Insufficient Dilatation - Cervix	Gloves - Examination
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No room around shoulders/hips	Insufficient Dilatation - Vagina	Tiredness
Felt Tight	Insufficient Dilatation - Vulva	High Workload
The front legs were crossed	Uterine Torsion - Present	
Maternal Undersize	Uterine Torsion - Direction	
Dam Deformities	Uterine Torsion - Location	
Dam Concurrent Disease	Uterine Torsion - Degree Uterine Tear - Location	

Animal Restraint and Surgical Preparation

Inadequate Lighting	Restraint - Head Halter	Field Antiseptic 1
Cleanliness – Dam	Restraint - Nose Pincers	Field Antiseptic 2
Cleanliness - Operation Pen	Restraint - Leg Rope	Surgeon Antiseptic 1
Cleanliness - Water provided	Restraint - Tail String	Surgeon Antiseptic 2
Cleanliness - Surgical Assistant	Restraint - Purpose built cattle chute	Clothing – Single Use
Dam Position	Restraint - Neck Band	Clothing – Sterile
Elected to operate recumbent	Restraint - Head Bag	Clothing – Laparotomy onward
Planipart (Clenbuterol)	Restraint - Shackles Restraint - Belly Rope	Clothing – Hysterotomy onward Gloves – Sterile

Hair Removal - Clippers/Scissors	Gloves – Disinfected
Hair Removal - Blade	Gloves – Laparotomy onward
Hair Removal - Razor	Gloves – Hysterotomy onward
Hair Removal - Location	Drape

Anesthesia

Anaesthesia - Timing	Inverted L or Line Block - Amount (ml)
Anaesthesia - Product	Inverted L or Line Block – Number of Sites
Anaesthesia - Epidural \leq 5 ml	Paravertebral T13 - Amount (ml)
Anaesthesia - Epidural $>$ 5 ml	Paravertebral L1 - Amount (ml) Paravertebral L2 - Amount (ml) Paravertebral L3 - Amount (ml)

Laparotomy

Surgical Assistance	Laparotomy - Location	Skin incision to calf removal - Duration
Rumen Incision	Laparotomy - Blade	Skin incision to skin suturing - Duration

Laparotomy - Arrival to departure - Duration

Scissors

Muscle Hemostasis

Muscle Adhesions

Handling of the Uterus

Gravid Horn

Uterus Characteristics -

Uterine Adhesions

Texture

Uterus Characteristics -

Uterus Rotation - Degrees

Tone

Uterus Characteristics -

Uterus Rotation - Tear

Colour

Uterus Exteriorize

Hysterotomy

Hysterotomy Incision -

Uterus Contents

Calf Legs - Traction Method

Shape

Hysterotomy Incision -

Uterus Contents - Meconium

Surgeon cut Umbilicus

Location

Hysterotomy - Blade

Retained Fetal Membranes

Hysterotomy - Scissors

Hysterotomy - Guarded

Blade

Hysterotomy - Extension

Skin Enlarge - Scissors

Skin Enlarge - Blade

Delivery and initial Care of the Newborn

Number of Calves	Calf Presentation	Condition of Calf - Calf 1
Calf Sex - 1	Calves - Simultaneous	Condition of Calf - Calf 2
Calf Sex - 2	Calf Position - 1	
Calf X-Breed - 1	Calf Position - 2	
Calf X-Breed - 2	Calf Posture 1 - Head	
Alive at 1st Exam - Calf 1	Calf Posture 1 - Front left leg	
Alive at 1st Exam - Calf 2	Calf Posture 1 - Front right leg	
Alive at Delivery - Calf 1	Calf Posture 1 - Rear left leg	
Alive at Delivery - Calf 2	Calf Posture 1 - Rear right leg	
	Calf Posture 2 - Head	
	Calf Posture 2 - Front left leg	
	Calf Posture 2 - Front right leg	
	Calf Posture 2 - Rear left leg	
	Calf Posture 2 - Rear right leg	

Suturing the Uterus

Uterus - Holding Method	Hysterotomy - Suture	Dissatisfied - Uterus
	Pattern	Suturing
	Hysterotomy - Suture	Dissatisfied - Operation
	Material	
	Hysterotomy - Stitching End	Dissatisfied - Cleanliness
	Hysterotomy - Oversewn	
	Abdominal Clots - Removed	
	Lavage - Isotonic Saline	
	Lavage - Antibiotics	
	Lavage - Clean Water	
	Sterile swab	
	Rumen / Intestine -	
	Exteriorize	

Suturing the Abdomen

Number of Suture Layers	Removed Muscle Free Air	Peritoneum Sutured
		Separately
	Muscle - Suture Pattern (*)	Peritoneum Material
	Muscle - Suture Material	
	Muscle - Start of Suturing	
	Skin - Suture Pattern	
	Skin - Suture Material	
	Skin - Start of Suturing	

Immediate Post-operative Treatment and Care of the Dam

Analgesia - Product	Antibiotic – Route	Oxytocin / Carbetocin - Amount (ml)
Analgesia - Timing	Antibiotic - Systemic - Product	Oxytocin Carbetocin - Timing
	Antibiotic - Systemic - Timing	Oxytocin / Carbetocin - Route
	Antibiotic - Systemic - Duration	Calcium - Amount (ml)
		Calcium - Route
		Sedative – Amount (ml)
		Sedative - Timing
		Sedative - Route

Questionnaire 2 – 14 d post-operatively

Dam Revisit - Date	Dam Vaginal Exam - Presence	Calf Alive 14 d - 1
Dam Alive 14 Days	Retained fetal membranes	Calf Alive 14 d - 2
Analgesia - Presence	Hyperthermia	Calf(ves) Remained with Dam
Skin Stitch Removal - Operator	Tachycardia	
Skin Wound Condition	Tachypnoea	
Dehiscence - Presence	Inappetence	
	Demeanour	
	Vulvar Discharge	
	Diarrhea	

Mastitis

Recumbency

Questionnaire 3 – 12 mo Post-operatively (done 18 mo post-operatively)

Dam Alive 12 mo

Calf Alive 12 mo - 1

Dam Pregnant

Calf Alive 12 mo - 2

(*) All enrolled cases had their muscle layers stitched with simple continuous suture pattern.

Table S2A: Table outlining baseline characteristics for 30 veterinary practices that actively participated in the bovine caesarean section audit, submitting data over a 2-year study period (Nov 2013 – Oct 2015). Values are n (%), mean (\pm SD), range (min, max), median (IQR) or P-value.

	Mean	SD	min	max	p50	IQR
Total Dams Under Care	17,182.30	12,439.47	2,900	59,000	14,200	17,000
Total Calvings Attended	215.73	165.10	27	759	168.50	173
Calvings of all Dams (%)	1.49	1.01	0.25	5.23	1.16	1.10
Total C-Sections	115.97	107.29	9	464	102	79
C-sections of all Dams (%)	0.75	0.56	0.18	2.51	0.64	0.58
C-sections of all Calvings (%)	51.31	19.20	20.64	92.10	47.82	34.04
Total C-sections Submitted	105.17	109.09	2	464	75.50	77
Submitted of Total C-sections (%)	85.97	23.55	22.22	100	100	28.28

Table S2B: Table outlining overall baseline characteristics for dams that underwent caesarean section, collected on the day of enrolment and relating to the veterinarian and veterinary clinic. Values are n (%), mean (\pm SD), range (min, max), median (IQR) or P-value. Numbers in brackets are percentages, unless specified otherwise. Percentages are based on column totals.

Overall	
	n = 2,904
Region - Participating Practices - Submitted Cases	
Scotland	6 (20.00)
Northern Ireland	0 (0.00)
Wales	3 (10.00)
North England	4 (13.33)
Midlands	8 (26.67)
East & South-East	4 (13.33)
England	
South-West England	5 (16.67)
<i>Numbers Missing</i>	<i>0 (0)</i>
Region - Participating Veterinarians - Submitted Cases	
Scotland	44 (20.37)

Northern Ireland	0 (0.00)
Wales	13 (6.02)
North England	43 (19.91)
Midlands	57 (26.39)
East & South-East	23 (10.65)
England	
South-West England	36 (16.67)
<i>Numbers Missing</i>	<i>0 (0)</i>

Top 10 Participating Clinics (Name Replaced by Random Number) - Submitted Cases

19	413 (14.22)
16	282 (9.71)
28	231 (7.95)
11	215 (7.40)
27	141 (4.86)
7	125 (4.30)
1	112 (3.86)
21	102 (3.51)
27	100 (3.44)

24	90 (3.10)
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<i>Numbers Missing</i>	<i>0 (0)</i>
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Top 10 Participating Veterinarians (Name Replaced by Random Number) -

Submitted Cases

113	62 (2.13)
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109	60 (2.07)
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7	55 (1.89)
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428	53 (1.83)
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284	47 (1.62)
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468	47 (1.62)
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310	39 (1.34)
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216	38 (1.31)
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432	37 (1.27)
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91	36 (1.24)
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<i>Numbers Missing</i>	<i>0 (0)</i>
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Table S2C: Table outlining baseline characteristics for dams that underwent caesarean section, collected on the day of enrolment and relating to participating veterinarians and their

clinics, showing the data distribution between dairy and beef dams enrolled. Values are n (%), mean (\pm SD), range (min, max), median (IQR) or P-value. Numbers in brackets are percentages, unless specified otherwise. Percentages are based on column totals.

	Overall	Beef	Dairy
	n = 2,904	n = 2,265 (78.00)	n = 639 (22.00)
Region - Enrolled Cases			
Scotland	1,119 (38.53)	1,064 (46.98)	55 (8.61)
Northern Ireland	0 (0.00)	0 (0.00)	0 (0.00)
Wales	194 (6.68)	145 (6.40)	49 (7.67)
North England	627 (21.59)	490 (21.63)	137 (21.44)
Midlands	657 (22.62)	414 (18.28)	243 (38.03)
East & South-East England	70 (2.41)	54 (2.38)	16 (2.50)
South-West England	237 (8.16)	98 (4.33)	139 (21.75)
<i>P-value</i>			<0.001
<i>Numbers Missing</i>	0 (0)	0 (0)	0 (0)
Veterinarian's Clinical Experience - Years			
Mean (\pm SD)	11.90 (10.24)	12.47 (10.53)	9.89 (8.89)

Range [Min, Max]	[1, 39]	[1, 39]	[1, 37]
Median (IQR)	8 (14)	8 (18)	6 (8)
<i>Numbers Missing</i>	0 (0)	0 (0)	0 (0)
≤ 1 y	96 (3.31)	64 (2.83)	32 (5.01)
1.1 - 3 y	627 (21.59)	501 (22.12)	126 (19.72)
3.1 – 5 y	378 (13.02)	271 (11.96)	107 (16.74)
5.1 – 20 y	1,121 (38.60)	835 (36.87)	286 (44.76)
20.1 > y	682 (23.48)	594 (26.23)	88 (13.77)
<i>P-value</i>			<0.001
<i>Numbers Missing</i>	0 (0)	0 (0)	0 (0)

Veterinarian's Gender

Female	1,161 (39.98)	891 (39.34)	270 (42.25)
Male	1,743 (60.02)	1,374 (60.66)	369 (57.75)
<i>P-value</i>			0.184
<i>Numbers Missing</i>	0 (0)	0 (0)	0 (0)

Month of Surgery

January	167 (5.75)	107 (4.72)	60 (9.39)
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February	207 (7.13)	149 (6.58)	58 (9.08)
March	475 (16.36)	394 (17.40)	81 (12.68)
April	508 (17.49)	460 (20.31)	48 (7.51)
May	385 (13.26)	334 (14.75)	51 (7.98)
June	293 (10.09)	246 (10.86)	47 (7.36)
July	180 (6.20)	130 (5.74)	50 (7.82)
August	130 (4.48)	96 (4.24)	34 (5.32)
September	113 (3.89)	66 (2.91)	47 (7.36)
October	111 (3.82)	80 (3.53)	31 (4.85)
November	189 (6.51)	116 (5.12)	73 (11.42)
December	146 (5.03)	87 (3.84)	59 (9.23)
<i>P-value</i>			<i><0.001</i>
<i>Numbers Missing</i>	<i>0 (0)</i>	<i>0 (0)</i>	<i>0 (0)</i>

During Normal Opening Hours - Monday to Friday 08:00 to 18:00

Yes	1,325 (45.63)	1,003 (44.28)	322 (50.39)
No	1,579 (54.37)	1,262 (55.72)	317 (49.61)
<i>P-value</i>			<i>0.006</i>
<i>Numbers Missing</i>	<i>0 (0)</i>	<i>0 (0)</i>	<i>0 (0)</i>

Surgeon High Workload

No	1,937 (66.70)	1,481 (65.39)	456 (71.36)
Yes	967 (33.30)	784 (34.61)	183 (28.64)
<i>P-value</i>			0.005
<i>Numbers Missing</i>	0 (0)	0 (0)	0 (0)

Duration: Skin Incision to Calf Removal (min)

Up to 15 min	2,416 (83.20)	1,921 (84.81)	495 (77.46)
16 to 30 min	419 (14.43)	298 (13.16)	121 (18.94)
31 to 45 min	48 (1.65)	33 (1.46)	15 (2.35)
46 to 60 min	18 (0.62)	12 (0.53)	6 (0.94)
Over 60 min	3 (0.10)	1 (0.04)	2 (0.31)
<i>P-value</i>			<0.001
<i>Numbers Missing</i>	0 (0)	0 (0)	0 (0)

Duration: Arrival to Departure (min)

40 to 60 min	402 (13.84)	358 (15.81)	44 (6.89)
61 to 75 min	524 (18.04)	452 (19.96)	72 (11.27)
76 to 90 min	870 (29.96)	672 (29.67)	198 (30.99)

91 to 105 min	375 (12.91)	290 (12.80)	85 (13.30)
106 to 120 min	244 (8.40)	176 (7.77)	68 (10.64)
Over 120 min	489 (16.84)	317 (14.00)	172 (26.92)
<i>P-value</i>			<0.001
<i>Numbers Missing</i>	0 (0)	0 (0)	0 (0)

Table S2D: Table outlining baseline characteristics for dams that underwent Caesarean section, collected on the day of enrolment and relating to the dam and clinical findings of the pre-operative examination, showing the data distribution between dairy and beef dams enrolled. Values are n (%), mean (\pm SD), range (min, max), median (IQR) or P-value. Numbers in brackets are percentages, unless specified otherwise. Percentages are based on column totals.

	Overall	Beef	Dairy
	n = 2,904	n = 2,265 (78.00)	n = 639 (22.00)
Previous C-sections			
No	2,685 (92.46)	2,056 (90.77)	629 (98.44)
Yes	219 (7.54)	209 (9.03)	10 (1.56)
<i>P-value</i>			<0.001
<i>Numbers Missing</i>	0 (0)	0 (0)	0 (0)

Dam Breed

Purebred	1,150 (39.60)	685 (30.24)	465 (72.77)
Crossbred	1,1754 (60.40)	1,580 (69.76)	174 (27.23)
<i>P-value</i>			<i><0.001</i>
<i>Numbers Missing</i>	<i>0 (0)</i>	<i>0 (0)</i>	<i>0 (0)</i>

Cause of Dystocia – No Room Around Shoulders or Hips

No Room	2,801 (75.56)	2,065 (72.38)	736 (86.18)
Yes, there was Room	906 (24.44)	788 (27.62)	118 (13.82)
<i>P-value</i>			<i><0.001</i>
<i>Numbers Missing</i>	<i>0 (0)</i>	<i>0 (0)</i>	<i>0 (0)</i>

Cause of Dystocia – Forelimbs were Crossed

No	2,207 (76.00)	1,653 (72.98)	554 (86.70)
Yes	697 (24.00)	612 (27.02)	85 (13.30)
<i>P-value</i>			<i><0.001</i>
<i>Numbers Missing</i>	<i>0 (0)</i>	<i>0 (0)</i>	<i>0 (0)</i>

Cause of Dystocia – Maternal Undersize (As Inspected, by Attending Veterinarian)

No	2,142 (73.76)	1,629 (71.92)	513 (80.28)
Yes	762 (26.24)	636 (28.08)	126 (19.72)

P-value <0.001

Numbers Missing 0 (0) 0 (0) 0 (0)

Uterine Torsion

No 2,625 (90.39) 2,149 (94.88) 476 (74.49)

Yes 279 (9.61) 116 (5.12) 163 (25.51)

P-value <0.001

Numbers Missing 0 (0) 0 (0) 0 (0)

Uterine Torsion Direction

No Torsion 2,625 (90.39) 2,149 (94.88) 476 (74.49)

Anticlockwise 206 (7.09) 89 (3.93) 117 (18.31)

Clockwise 73 (2.52) 27 (1.19) 46 (7.20)

P-value <0.001

Numbers Missing 0 (0) 0 (0) 0 (0)

Uterine Tear

No 2,880 (99.17) 2,252 (99.43) 628 (98.28)

Yes 24 (0.83) 13 (0.57) 11 (1.72)

P-value 0.005

Numbers Missing 0 (0) 0 (0) 0 (0)

Insufficient Dilatation of the Cervix (Veterinarian's initial Palpation)

Completely Dilated	2,327 (80.13)	1,927 (85.08)	400 (62.60)
Palpable Constriction	577 (19.87)	338 (14.92)	239 (37.40)
<i>P-value</i>			<0.001
<i>Numbers Missing</i>	0 (0)	0 (0)	0 (0)

Table S2E: Table outlining baseline characteristics for dams that underwent Caesarean section, collected on the day of enrolment and relating to the handling of the dam during surgery, while showing the data distribution between dairy and beef dams enrolled. Values are n (%), mean (\pm SD), range (min, max), median (IQR) or P-value. Numbers in brackets are percentages, unless specified otherwise. Percentages are based on column totals.

	Overall	Beef	Dairy
	n = 2,904	n = 2,265 (78.00)	n = 639 (22.00)

Dam Position During Surgery

Lying Down	308 (10.61)	198 (8.74)	110 (17.22)
Lying Down & Standing	370 (12.74)	265 (11.70)	105 (16.43)
Standing	2,226 (76.65)	1,802 (79.56)	424 (66.35)
<i>P-value</i>			<0.001
<i>Numbers Missing</i>	0 (0)	0 (0)	0 (0)

Elective Recumbency

No	2,640 (90.91)	2,079 (91.79)	561 (87.79)
Yes	264 (9.09)	186 (8.21)	78 (12.21)
<i>P-value</i>			0.002
<i>Numbers Missing</i>	0 (0)	0 (0)	0 (0)

Antisepsis – Surgical Field – First Product

Chlorhexidine gluconate 4%	1,392 (47.93)	1,069 (47.20)	323 (50.55)
Povidone iodine 10%	1,459 (50.24)	1,152 (50.86)	307 (48.04)
Other	53 (1.83)	44 (1.94)	9 (1.41)
<i>P-value</i>			0.255
<i>Numbers Missing</i>	0 (0)	0 (0)	0 (0)

Antisepsis – Surgical Field – Second Product

Did not use 2 nd product	846 (29.13)	780 (34.44)	66 (10.33)
Methyl salicylate 0.5%	1,943 (66.91)	1,395 (61.59)	548 (85.76)
Other	115 (3.96)	90 (3.97)	25 (3.91)
<i>P-value</i>			<0.001
<i>Numbers Missing</i>	0 (0)	0 (0)	0 (0)

Antisepsis – Surgeon – First Product

Chlorhexidine gluconate 4%	1,514 (52.13)	1,159 (51.17)	355 (55.56)
Povidone iodine 10%	1,357 (46.73)	1,079 (47.64)	278 (43.51)
Other	33 (1.14)	27 (1.19)	6 (0.94)
<i>P-value</i>			0.139
<i>Numbers Missing</i>	0 (0)	0 (0)	0 (0)

Antisepsis – Surgeon – Second Product

Did not use 2 nd product	2,361 (90.60)	2,067 (91.26)	564 (88.26)
Methyl salicylate 0.5%	198 (6.82)	140 (6.18)	58 (9.08)
Other	75 (2.58)	58 (2.56)	17 (2.66)
<i>P-value</i>			0.036
<i>Numbers Missing</i>	0 (0)	0 (0)	0 (0)

Anaesthesia Product

Procaine & Epinephrine 0.02%	1,373 (47.28)	1,063 (46.93)	310 (48.51)
Procaine & Epinephrine 0.002%	364 (12.53)	202 (8.92)	162 (25.35)
Lidocaine & Epinephrine 0.002%	1,167 (40.19)	1,000 (44.15)	167 (26.14)
<i>P-value</i>			<0.001

<i>Numbers Missing</i>	<i>0 (0)</i>	<i>0 (0)</i>	<i>0 (0)</i>
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Anaesthesia Type – Regional or Local

Line or Inverted L Block	2,020 (69.56)	1,577 (69.62)	443 (69.33)
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Paravertebral	884 (30.44)	688 (30.38)	196 (30.67)
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<i>P-value</i>			<i>0.885</i>
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<i>Numbers Missing</i>	<i>0 (0)</i>	<i>0 (0)</i>	<i>0 (0)</i>
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Epidural Use

No	1,858 (63.98)	1,551 (68.48)	307 (48.04)
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Yes	1,046 (36.02)	714 (31.52)	332 (51.96)
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<i>P-value</i>			<i>0.001</i>
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<i>Numbers Missing</i>	<i>0 (0)</i>	<i>0 (0)</i>	<i>0 (0)</i>
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Laparotomy Type

Flank	2,901 (99.90)	2,263 (99.91)	638 (99.84)
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<i>Left Flank</i>	<i>2,885</i>	<i>2,254</i>	<i>631</i>
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<i>Right Flank</i>	<i>16</i>	<i>9</i>	<i>7</i>
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Paramedian	3 (0.10)	2 (0.09)	1 (0.16)
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<i>P-value</i>			<i>0.152</i>
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<i>Numbers Missing</i>	<i>0 (0)</i>	<i>0 (0)</i>	<i>0 (0)</i>
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Surgical Assistance – Veterinarian

No Assistance	458 (15.77)	360 (15.89)	98 (15.34)
Producer	1,626 (55.99)	1,328 (58.63)	298 (46.64)
Vet	476 (16.39)	298 (13.16)	178 (27.86)
Student	218 (7.51)	177 (7.81)	41 (6.40)
Other	126 (4.34)	102 (4.51)	24 (3.76)
<i>P-value</i>			<0.001
<i>Numbers Missing</i>	0 (0)	0 (0)	0 (0)

Table S2F: Table outlining baseline characteristics for dams that underwent Caesarean section, collected on the day of enrolment and relating to the handling of the hysterotomic segment of the surgery, while showing the data distribution between dairy and beef dams enrolled. Values are n (%), mean (\pm SD), range (min, max), median (IQR) or P-value. Numbers in brackets are percentages, unless specified otherwise. Percentages are based on column totals.

	Overall	Beef	Dairy
	n = 2,904	n = 2,265 (78.00)	n = 639 (22.00)
Uterine Texture			
Normal	2,625 (90.39)	2,084 (92.01)	541 (84.66)

Friable	279 (9.61)	181 (7.99)	98 (15.34)
<i>P-value</i>			<i><0.001</i>
<i>Numbers Missing</i>	<i>0 (0)</i>	<i>0 (0)</i>	<i>0 (0)</i>

Uterine Color

Normal	2,678 (92.22)	2,134 (94.22)	544 (85.14)
Pale	119 (4.10)	74 (3.27)	45 (7.04)
Congested	107 (3.68)	57 (2.51)	50 (7.82)
<i>P-value</i>			<i><0.001</i>
<i>Numbers Missing</i>	<i>0 (0)</i>	<i>0 (0)</i>	<i>0 (0)</i>

Uterine Adhesions

No	2,825 (97.28)	2,195 (96.91)	630 (98.59)
Yes	79 (2.72)	70 (3.09)	9 (1.41)
<i>P-value</i>			<i>0.021</i>
<i>Numbers Missing</i>	<i>0 (0)</i>	<i>0 (0)</i>	<i>0 (0)</i>

Uterine Handling – Rotation Difficulty

No Rotation	2,102 (72.38)	1,668 (73.64)	434 (67.92)
Easy	280 (9.64)	224 (9.89)	56 (8.76)
Some Difficulty	383 (13.19)	274 (12.10)	109 (17.06)

Very Difficult	139 (4.79)	99 (4.37)	40 (6.26)
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<i>P-value</i>			0.001
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<i>Numbers Missing</i>	0 (0)	0 (0)	0 (0)
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Hysterotomy – Suture Pattern

Cushing	1,383 (47.62)	1,139 (50.26)	244 (38.24)
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Lembert	554 (19.08)	464 (20.48)	90 (14.11)
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Utrecht	967 (33.30)	663 (29.26)	304 (47.65)
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<i>P-value</i>			<0.001
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<i>Numbers Missing</i>	0 (0)	0 (0)	0 (0)
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Hysterotomy – Suture Material

Chrome Catgut	2,161 (74.42)	1,675 (73.92)	486 (76.18)
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Vicryl	460 (15.84)	362 (15.98)	98 (15.35)
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Polydioxanone (PDS)	143 (4.92)	114 (5.02)	29 (4.55)
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Other	140 (4.82)	115 (5.08)	25 (3.92)
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<i>P-value</i>			0.576
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<i>Numbers Missing</i>	0 (0)	0 (0)	0 (0)
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Hysterotomy Cleaning (Some Dams Received > 1)

No Cleaning	564 (N/A)	436 (N/A)	128 (N/A)
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Normal Saline Lavage	296 (N/A)	219 (N/A)	77 (N/A)
Antibiotic Lavage	477 (N/A)	405 (N/A)	72 (N/A)
Potable Water Lavage	592 (N/A)	500 (N/A)	92 (N/A)
Sterile Swab	1,290 (N/A)	960 (N/A)	330 (N/A)
<i>P-value</i>			<i>N/A</i>
<i>Numbers Missing</i>	<i>0 (0)</i>	<i>0 (0)</i>	<i>0 (0)</i>

Abdominal Blood Clots

Removed	2,550 (87.81)	1,956 (86.36)	594 (92.96)
Remained	354 (12.19)	309 (13.64)	45 (7.04)
<i>P-value</i>			<i><0.001</i>
<i>Numbers Missing</i>	<i>0 (0)</i>	<i>0 (0)</i>	<i>0 (0)</i>

Peritoneum sutured separately

No	2,625 (90.39)	2,022 (89.27)	603 (94.37)
Yes	279 (9.61)	243 (10.73)	36 (5.63)
<i>P-value</i>			<i><0.001</i>
<i>Numbers Missing</i>	<i>0 (0)</i>	<i>0 (0)</i>	<i>0 (0)</i>

Skin – Suture Pattern

Simple Continuous	403 (13.88)	318 (14.04)	85 (13.30)
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Interlocking	1,157 (39.84)	855 (37.75)	302 (47.26)
Interrupted	1,344 (46.28)	1,092 (48.21)	252 (39.44)
<i>P-value</i>			<i><0.001</i>
<i>Numbers Missing</i>	<i>0 (0)</i>	<i>0 (0)</i>	<i>0 (0)</i>

Skin – Suture Material

Nylon Supramid	2,650 (91.25)	2,113 (93.29)	537 (84.04)
Other	254 (8.75)	152 (6.71)	102 (15.96)
<i>P-value</i>			<i><0.001</i>
<i>Numbers Missing</i>	<i>0 (0)</i>	<i>0 (0)</i>	<i>0 (0)</i>

Post-op Cleanliness – Dissatisfied

No	2,692 (92.70)	2,086 (92.10)	606 (94.84)
Yes	212 (7.30)	179 (7.90)	33 (5.16)
<i>P-value</i>			<i>0.019</i>
<i>Numbers Missing</i>	<i>0 (0)</i>	<i>0 (0)</i>	<i>0 (0)</i>

Table S2G: Table outlining baseline characteristics for cattle that underwent caesarean section, collected on the day of enrolment and relating to features of the delivered calf, while showing the data distribution between dairy and beef cattle enrolled. Values are n (%), mean (\pm SD), range (min, max), median (IQR) or P-value. Numbers in brackets are percentages, unless specified otherwise. Percentages are based on column totals.

	Overall	Beef	Dairy
	n = 2,904	n = 2,265 (78.00)	n = 639 (22.00)

Calf Sex – 1st Calf

Female	571 (19.66)	425 (18.76)	146 (22.85)
Male	2,026 (69.77)	1,617 (71.39)	409 (64.00)
Don't Know	307 (10.57)	223 (9.85)	84 (13.15)
<i>P-value</i>			0.001
<i>Numbers Missing</i>	0 (0)	0 (0)	0 (0)

Calf Sex – 2nd Calf

Female	13 (0.45)	10 (0.44)	3 (0.47)
Male	17 (0.59)	8 (0.35)	9 (1.41)
Don't Know	9 (0.31)	8 (0.35)	1 (0.16)
Not Applicable (Singleton)	2,865 (98.66)	2,239 (98.85)	626 (97.97)
<i>P-value</i>			0.017
<i>Numbers Missing</i>	0 (0)	0 (0)	0 (0)

Calf State – 1st Calf

Normal	2,799 (96.38)	2,214 (97.75)	585 (91.55)
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Emphysematous	53 (1.83)	28 (1.23)	25 (3.91)
Putrefied (Hair / Skin / Hooves sloughing)	52 (1.79)	23 (1.02)	29 (4.54)
<i>P-value</i>			<i><0.001</i>
<i>Numbers Missing</i>	<i>0 (0)</i>	<i>0 (0)</i>	<i>0 (0)</i>

Calf Breed – 1st Calf

Purebred	890 (30.65)	670 (29.58)	220 (34.43)
Crossbred	2,014 (69.35)	1,595 (70.42)	419 (65.57)
<i>P-value</i>			<i>0.019</i>
<i>Numbers Missing</i>	<i>0 (0)</i>	<i>0 (0)</i>	<i>0 (0)</i>

Calf Presentation

Anterior	2,286 (78.72)	1,798 (79.38)	488 (76.37)
Posterior	407 (14.01)	324 (14.30)	83 (12.99)
Transverse	211 (7.27)	143 (6.32)	68 (10.64)
<i>P-value</i>			<i>0.001</i>
<i>Numbers Missing</i>	<i>0 (0)</i>	<i>0 (0)</i>	<i>0 (0)</i>

Calf Presentation - Simultaneous

No	26 (0.90)	17 (0.75)	9 (1.41)
Yes	13 (0.45)	9 (0.40)	4 (0.63)

Singleton – N/A	2,865 (98.65)	2,239 (98.85)	626 (97.97)
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<i>P-value</i>			0.220
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<i>Numbers Missing</i>	0 (0)	0 (0)	0 (0)
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Calf Position – 1st Calf

Dorsal	2,454 (84.50)	1,1953 (86.23)	501 (78.40)
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Ventral	239 (8.23)	169 (7.46)	70 (10.95)
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Transverse	211 (7.27)	143 (6.31)	68 (10.64)
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<i>P-value</i>			<0.001
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<i>Numbers Missing</i>	0 (0)	0 (0)	0 (0)
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Calf Posture – 1st Calf (Some Calves had > 1 Malposture)

Head - Normal	1,992 (N/A)	1,647 (N/A)	345 (N/A)
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Head - Downward Deviation	58 (N/A)	23 (N/A)	35 (N/A)
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Head - Lateral Deviation	236 (N/A)	128 (N/A)	108 (N/A)
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Fore Limb - Left - Normal	2,154 (N/A)	1,712 (N/A)	442 (N/A)
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Ext Elbow & Flx Carpus - Left	42 (N/A)	29 (N/A)	13 (N/A)
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Flx Elbow & Ext Carpus - Left	63 (N/A)	45 (N/A)	18 (N/A)
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Fore Limb Backward - Left	27 (N/A)	12 (N/A)	15 (N/A)
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Fore Limb - Right - Normal	2,150 (N/A)	1,711 (N/A)	439 (N/A)
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Ext Elbow & Flx Carpus - Right	46 (N/A)	28 (N/A)	18 (N/A)
Flx Elbow & Ext Carpus - Right	67 (N/A)	49 (N/A)	18 (N/A)
Fore Limb Backward - Right	23 (N/A)	10 (N/A)	13 (N/A)
Hind Limb - Left - Normal	352 (N/A)	291 (N/A)	61 (N/A)
Flx Hip & Flx Tarsus - Left	14 (N/A)	5 (N/A)	9 (N/A)
Flx Hip & Ext Tarsus - Left	41 (N/A)	28 (N/A)	13 (N/A)
Hind Limb - Right - Normal	350 (N/A)	289 (N/A)	61 (N/A)
Flx Hip & Flx Tarsus - Right	19 (N/A)	8 (N/A)	11 (N/A)
Flx Hip & Ext Tarsus - Right	38 (N/A)	27 (N/A)	11 (N/A)
<i>P-value</i>			<i>N/A</i>
<i>Numbers Missing</i>	<i>0 (0)</i>	<i>0 (0)</i>	<i>0 (0)</i>

Table S2H: Table outlining baseline characteristics for cattle that underwent Caesarean section, collected on the day of enrolment and associated with medications administered prior or following the operation, while showing the data distribution between dairy and beef dams enrolled. Values are n (%), mean (\pm SD), range (min, max), median (IQR) or P-value. Numbers in brackets are percentages, unless specified otherwise. Percentages are based on column totals.

	Overall	Beef	Dairy
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n = 2,904	n = 2,265	n = 639 (22.00)
	(78.00)	

Xylazine 2% – Amount used in mg (783 treated cattle)

Mean (\pm SD)	31.60 (30.20)	32.60 (31.60)	27 (23)
Range [Min, Max]	[4, 180]	[4, 180]	[6, 110]
Median (IQR)	20 (28)	20 (28)	20 (22)

Xylazine 2% – Dosage Categories

None Given	2,121 (73.04)	1,630 (71.96)	491 (76.84)
1-20 mg	475 (16.36)	382 (16.87)	93 (14.55)
21-40 mg	162 (5.58)	128 (5.65)	34 (5.32)
Over 40 mg	146 (5.02)	125 (5.52)	21 (3.29)
<i>P-value</i>			0.040
<i>Numbers Missing</i>	0 (0)	0 (0)	0 (0)

Clenbuterol Hydrochloride – 30 μ g/mL

None Given	732 (25.21)	566 (24.99)	166 (25.98)
Administered	2,172 (74.79)	1,699 (75.01)	473 (74.02)
<i>P-value</i>			0.611
<i>Numbers Missing</i>	0 (0)	0 (0)	0 (0)

Analgesia Product

Producer Administered	5 (1.93)	46 (2.03)	10 (1.56)
Meloxicam	2,183 (75.17)	1,706 (75.32)	477 (74.65)
Flunixin	555 (19.11)	443 (19.56)	112 (17.53)
Ketoprofen	92 (3.17)	59 (2.60)	33 (5.16)
Other	18 (0.62)	11 (0.49)	7 (1.10)
<i>P-value</i>			0.005
<i>Numbers Missing</i>	0 (0)	0 (0)	0 (0)

Oxytocin / Carbetocin

None Given	1,680 (57.85)	1,399 (61.77)	281 (43.97)
Carbetocin	85 (2.93)	65 (2.87)	20 (3.13)
Oxytocin	1,139 (39.22)	801 (35.36)	338 (52.90)
<i>P-value</i>			<0.001
<i>Numbers Missing</i>	0 (0)	0 (0)	0 (0)

Calcium Borogluconate 40%

No	2,770 (95.39)	2,230 (98.45)	540 (84.51)
Yes	134 (4.61)	35 (1.55)	99 (15.49)
<i>P-value</i>			<0.001

<i>Numbers Missing</i>	0 (0)	0 (0)	0 (0)
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Antibiotics Systemic - Products

Procaine Penicillin & Dihydrostreptomycin Sulphate	1,625 (55.96)	1,347 (59.44)	278 (43.57)
Tylosin	520 (17.91)	453 (19.99)	67 (10.50)
Amoxicillin Trihydrate & Clavulanic Acid	497 (17.11)	314 (13.86)	183 (28.68)
Amoxicillin Trihydrate	167 (5.75)	91 (4.02)	76 (11.92)
Other	95 (3.27)	61 (2.69)	34 (5.33)

<i>P-value</i>			<0.001
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<i>Numbers Missing</i>	0 (0)	0 (0)	0 (0)
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Antibiotics – Location (> 1 Locations for Some Dams)

Intra-uterine	56 (N/A)	39 (N/A)	17 (N/A)
Hysterotomic Incision	477 (N/A)	405 (N/A)	72 (N/A)
Intra-peritoneally	1,270 (N/A)	1,052 (N/A)	218 (N/A)
Muscle Layers	575 (N/A)	484 (N/A)	91 (N/A)
Skin Incision (Spray)	2,149 (N/A)	1,601 (N/A)	548 (N/A)
Systemic	2,904 (N/A)	2,265 (N/A)	639 (N/A)

<i>P-value</i>			N/A
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Numbers Missing

0 (0)

0 (0)

0 (0)

Table S2I: Table outlining baseline characteristics for dams that underwent Caesarean section, collected on the day of enrolment and demonstrating correlations between selected explanatory variables, based on chi-square analysis and would be of interest in literature review. Values are n (%), mean (\pm SD), range (min, max), median (IQR) or P-value. Numbers in brackets are percentages, unless specified otherwise. Percentages are based on column totals.

Duration: Skin Incision to Calf Removal (min)					
Experience (y)	Up to 15	16 to 30	31 to 45	46 to 60	Over 60
< 1	58 (2.40)	35 (8.35)	1 (2.08)	2 (11.11)	0 (0.00)
1.1 to 3	513 (21.23)	96 (22.91)	13 (27.08)	4 (22.22)	1 (33.33)
3.1 to 5	306 (12.67)	54 (12.89)	11 (22.92)	5 (27.78)	2 (66.67)
5.1 to 20	948 (39.24)	152 (36.28)	14 (29.17)	7 (39.89)	0 (0.00)
> 20	591 (24.46)	82 (19.57)	9 (18.75)	0 (0.00)	0 (0.00)
<i>P-value</i>					<0.001
<i>Numbers Missing</i>	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

Calf State – 1st Calf

Hysterotomy – Oversewn	Normal	Emphysematous	Putrefied (Hair / Skin / Hooves peeling off)
Not Oversewn	2,677 (95.64)	53 (100.00)	48 (92.31)
Oversewn	122 (4.36)	0 (0.00)	4 (7.69)
<i>P-value</i>			0.956
<i>Numbers Missing</i>	0 (0)	0 (0)	0 (0)

Xylazine 2%

Dam Position	No	Yes
Lying Down	162 (7.64)	146 (18.65)
Lying Down & Standing	231 (10.89)	139 (17.75)
Standing	1,728 (81.47)	498 (63.60)
<i>P-value</i>		<0.001
<i>Numbers Missing</i>	0 (0)	0 (0)

Xylazine 2% – Dosage Categories

Dam Position	None Given	1-20 mg	21-40 mg	> 40 mg
Lying Down	162 (7.64)	44 (9.26)	39 (24.07)	63 (43.15)
Lying Down & Standing	213 (10.89)	69 (14.53)	36 (22.21)	34 (23.29)
Standing	1,728 (81.47)	362 (76.21)	87 (53.70)	49 (33.56)
<i>P-value</i>				<0.001
<i>Numbers Missing</i>	0 (0)	0 (0)	0 (0)	0 (0)

Paravertebral

Dam Position	No	Yes
Lying Down	244 (12.08)	64 (7.24)
Lying Down & Standing	263 (13.02)	107 (12.10)
Standing	1,513 (74.90)	713 (80.66)
<i>P-value</i>		<0.001
<i>Numbers Missing</i>	0 (0)	0 (0)

Surgical Field Drape

Dam Position	No	Yes
Lying Down	254 (9.43)	54 (25.71)
Lying Down & Standing	333 (12.36)	37 (17.62)
Standing	2,107 (78.21)	119 (56.67)
<i>P-value</i>		<0.001
<i>Numbers Missing</i>	0 (0)	0 (0)

Uterus Exteriorize

Dam Position	Exteriorized	Not Exteriorized
Lying Down	222 (9.59)	87 (14.80)
Lying Down & Standing	298 (12.87)	71 (12.07)
Standing	1,796 (77.54)	430 (73.13)
<i>P-value</i>		0.002
<i>Numbers Missing</i>	0 (0)	0 (0)

Calf State – 1st Calf

Uterus Exteriorize	Normal	Emphysematous	Putrefied (Hair / Skin / Hooves peeling off)
Exteriorized	2,233 (79.78)	46 (86.79)	37 (71.15)
Not Exteriorized	566 (20.22)	7 (13.21)	15 (28.85)
<i>P-value</i>			<i>0.134</i>
<i>Numbers Missing</i>	<i>0 (0)</i>	<i>0 (0)</i>	<i>0 (0)</i>

Table S3: Table outlining univariable associations of all the strong and some weak predictors of the model and main outcome of events over a 2-year study period (Nov 2013 – Oct 2015), with primary outcome being dam deaths at 14 days post-operation. Values are n (%), mean (\pm SD), range (min, max), median (IQR) or P-value. Numbers in brackets are percentages, unless specified otherwise. Percentages are based on column totals.

	Overall	Dead at 14 d	Alive at 14 d
	n = 2,901	n = 214 (7.38)	n = 2,687 (92.62)

Skin Incision to Calf Removal - Blocks of 15 min

5 to 15 min	2,413 (83.18)	169 (78.97)	2,244 (83.51)
16 to 30 min	419 (14.44)	29 (13.56)	390 (14.51)
31 to 45 min	48 (1.66)	10 (4.67)	38 (1.42)
46 to 60 min	18 (0.62)	4 (1.87)	14 (0.52)
Over 60 min	3 (0.10)	2 (0.93)	1 (0.04)
<i>P-value</i>			<0.001
<i>Numbers Missing</i>	0 (0)	0 (0)	0 (0)

Variable Index – Uterus

0	1,543 (53.19)	97 (45.33)	1,446 (53.81)
1	929 (32.02)	53 (24.77)	876 (32.60)
2	231 (7.96)	25 (11.68)	206 (7.67)
3	88 (3.03)	12 (5.61)	76 (2.83)
4	69 (2.38)	13 (6.07)	56 (2.08)
5	41 (1.41)	14 (6.54)	27 (1.01)
<i>P-value</i>			<0.001
<i>Numbers Missing</i>	0 (0)	0 (0)	0 (0)

Paravertebral

No	2,017 (69.53)	168 (78.50)	1,849 (68.81)
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Yes	884 (30.47)	46 (21.50)	838 (31.19)
<i>P-value</i>			0.003
<i>Numbers Missing</i>	0 (0)	0 (0)	0 (0)

Variable Index – Surgeon Dissatisfaction

0	2,462 (84.87)	149 (69.63)	2,313 (86.08)
1	255 (8.79)	34 (15.89)	221 (8.23)
2	184 (6.34)	31 (14.50)	153 (5.69)
<i>P-value</i>			<0.001
<i>Numbers Missing</i>	0 (0)	0 (0)	0 (0)

Uterus Exteriorize

Exteriorized	2,315 (79.83)	149 (69.63)	2,166 (80.64)
Not Exteriorized	585 (20.17)	65 (30.37)	520 (19.36)
<i>P-value</i>			<0.001
<i>Numbers Missing</i>	0 (0)	0 (0)	0 (0)

Lactation number – Categories

1 st	1,579 (54.43)	91 (42.52)	1,488 (55.38)
2 nd	477 (16.44)	52 (24.30)	425 (15.82)
≥3 rd	845 (29.13)	71 (33.18)	774 (28.80)

P-value <0.001

Numbers Missing 0 (0) 0 (0) 0 (0)

Dam Position

Lying Down 308 (10.62) 43 (20.09) 265 (9.86)

Lying Down & Standing 370 (12.75) 31 (14.49) 339 (12.62)

Standing 2,223 (76.63) 140 (65.42) 2,083 (77.52)

P-value 0.019

Numbers Missing 0 (0) 0 (0) 0 (0)

Hysterotomy – Oversewn

Not Oversewn 2,776 (95.69) 212 (99.07) 2,564 (95.42)

Oversewn 125 (4.31) 2 (0.93) 123 (4.58)

P-value 0.012

Numbers Missing 0 (0) 0 (0) 0 (0)

Number of Calves

Singleton 2,862 (98.66) 207 (96.73) 2,655 (98.81)

Twins 39 (1.34) 7 (3.27) 32 (1.19)

P-value 0.011

Elect Lying Down

No	2,637 (90.90)	184 (85.98)	2,453 (91.29)
Yes	264 (9.10)	30 (14.02)	234 (8.71)
<i>P-value</i>			<i>0.009</i>
<i>Numbers Missing</i>	<i>0 (0)</i>	<i>0 (0)</i>	<i>0 (0)</i>

Alive at Delivery – 1st Calf

No	594 (20.48)	78 (36.45)	516 (19.20)
Yes	2,307 (79.52)	136 (63.55)	2,171 (80.80)
<i>P-value</i>			<i><0.001</i>
<i>Numbers Missing</i>	<i>0 (0)</i>	<i>0 (0)</i>	<i>0 (0)</i>

Calf State – 1st Calf

Normal	2,796 (96.38)	191 (89.25)	2,605 (96.95)
Emphysematous	53 (1.83)	8 (3.74)	45 (1.67)
Putrefied (Hair / Skin / Hooves peeling off)	52 (1.79)	15 (7.01)	37 (1.38)
<i>P-value</i>			<i>0.011</i>
<i>Numbers Missing</i>	<i>0 (0)</i>	<i>0 (0)</i>	<i>0 (0)</i>

Clenbuterol Hydrochloride – 30 µg/mL

None Given	730 (25.16)	59 (27.57)	671 (24.97)
Administered	2,171 (74.84)	155 (72.43)	2,016 (75.03)

<i>P-value</i>			0.399
<i>Numbers Missing</i>	0 (0)	0 (0)	0 (0)

Table S4: Table outlining main outcome of events over a 2-year study period (Nov 2013 – Oct 2015), with primary outcome being dam deaths at 14 d post-operation. Values are n (%), odds ratio or linear coefficient where indicated, 95% confidence interval, P-value and its interpretation. Numbers in brackets are percentages, unless specified otherwise. Percentages are based on column totals.

The analysis is based on single-level (unadjusted) and multi-level (adjusted) mixed effects regression with vet nested within practice as random effect. A reference group has been nominated in order to identify differences between cohorts.

Any differences in the total number of animals in each group that entered the single-level analysis and the total number in each equivalent group that enrolled into the multi-level one, are because of rejection of records due to collinearity.

Strong Predictors - Categorical Variables

Frequency	Odds Ratio	P-	Interpretation
N= (%)	(95% Conf Interval)	value	

Unadjusted

Overall Dead	214 (7.38)			
Skin to Calf Duration up to 15 min Dead	169 (7.00)	Reference		
Skin to Calf Duration 31 to 45min Dead	10 (20.83)	4.92 (2.16-11.22)	<0.001	Overwhelming evidence

Adjusted

Overall Dead	214 (7.38)			
Skin to Calf Duration up to 15min Dead	169 (7.01)	Reference		
Skin to Calf Duration 31 to 45min Dead	10 (20.83)	2.87 (1.20-6.88)	0.018	Some evidence

Total number of 2,901 dams were entered in the unadjusted analysis, whereas a total number of 2,900 animals were entered in the adjusted one.

Unadjusted

Overall Dead	214 (7.38)			
No Paravertebral Dead	168 (8.33)	Reference		

Paravertebral Dead	46 (5.20)	0.60 (0.40-0.91)	0.017	Some evidence
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Adjusted

Overall Dead	214 (7.38)
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No Paravertebral Dead	168 (8.33)	Reference
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Paravertebral Dead	46 (5.21)	0.63 (0.41-0.97)	0.038	Some evidence
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Total number of 2,017 dams with non-paravertebral anaesthetic and 884 with paravertebral in the unadjusted analysis. Total number of 2,017 dams with non-paravertebral anaesthetic and 883 with paravertebral in the adjusted analysis.

Unadjusted

Overall Dead	214 (7.38)
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Exteriorized Dead	149 (6.43)	Reference
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Not Exteriorized Dead	65 (11.11)	1.96 (1.30-2.96)	0.001	Strong evidence
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Adjusted

Overall Dead	214 (7.38)
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Exteriorized Dead	149 (6.44)	Reference		
Not Exteriorized Dead	65 (11.11)	1.89 (1.30-2.91)	0.004	Strong evidence

Total number of 2,316 dams that the uterus was exteriorized during hysterotomy and 585 that was not exteriorized in the unadjusted analysis. Total number of 2,315 dams that the uterus was exteriorized during hysterotomy and 585 that was not exteriorized in the adjusted analysis.

Unadjusted

Overall Dead	214 (7.38)			
Dairy Dams Dead	68 (10.64)	Reference		
Beef Dams Dead	146 (6.45)	0.47 (0.33 - 0.67)	<0.001	Overwhelming evidence

Adjusted

Overall Dead	214 (7.38)			
Dairy Dams Dead	68 (10.66)	Reference		
Beef Dams Dead	146 (6.45)	0.56 (0.38 - 0.82)	0.003	Strong evidence

Total number of 639 dairy and 2,262 beef dams in the unadjusted analysis. Total number of 638 dairy and 2,262 beef dams in the adjusted analysis.

Unadjusted

Overall Dead	214 (7.38)			
Primiparous Dead	91 (5.76)	Reference		
Second Parity Dead	52 (10.90)	1.92 (1.31-2.81)	0.001	Strong evidence

Adjusted

Overall Dead	214 (7.38)			
Primiparous Dead	91 (5.77)	Reference		
Second Parity Dead	52 (10.90)	2.01 (1.34-3.02)	0.001	Strong evidence

Total number of 2,901 dams were entered in the unadjusted analysis, whereas a total number of 2,900 dams were entered in the adjusted one.

Unadjusted

Overall Dead	214 (7.38)			
Lying Down Dead	43 (13.96)	Reference		

Standing Dead	140 (6.30)	0.37 (0.25-0.56)	<0.001	Overwhelming evidence
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Adjusted

Overall Dead	214 (7.38)			
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Lying Down Dead	43 (13.96)	Reference		
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Standing Dead	140 (6.30)	0.52 (0.33-0.81)	0.004	Strong evidence
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Total number of 2,776 dams that the hysterotomy was not oversewn and 125 that was oversewn in the unadjusted analysis.

Total number of 2,775 dams that the hysterotomy was not oversewn and 125 that was oversewn in the adjusted analysis.

Unadjusted

Overall Dead	214 (7.38)			
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Not Oversewn Dead	212 (7.64)	Reference		
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Oversewn Dead	2 (1.60)	0.20 (0.05-0.90)	0.035	Some evidence
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Adjusted

Overall Dead	214 (7.38)			
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Not Oversewn Dead	212 (7.64)	Reference		
Oversewn Dead	2 (1.60)	0.16 (0.04-0.75)	0.020	Some evidence

Total number of 2,776 dams that the hysterotomy was not oversewn and 125 that was oversewn in the unadjusted analysis.

Total number of 2,775 dams that the hysterotomy was not oversewn and 125 that was oversewn in the adjusted analysis.

Unadjusted

Overall Dead	214 (7.38)			
Singleton Dams Dead	207 (7.23)	Reference		
Twin Dams Dead	7 (17.95)	3.40 (1.38-8.34)	0.008	Some evidence

Adjusted

Overall Dead	214 (7.38)			
Singleton Dams Dead	207 (7.24)	Reference		
Twin Dams Dead	7 (17.95)	2.72 (1.01-7.32)	0.047	Some evidence

Total number of 2,862 dams that bore a singleton calf and 39 that bore twins in the unadjusted analysis. Total number of 2,861 dams that bore a singleton calf and 39 that bore twins in the adjusted analysis.

Strong Predictors - Continuous Variables

	Coefficient of Linear Regression	95% Conf Interval	P- value	Interpretation
Unadjusted				
Variable Index – Uterus	1.52	1.35-1.71	<0.001	Overwhelming evidence
Adjusted				
Variable Index – Uterus	1.35	1.18-1.54	<0.001	Overwhelming evidence
Unadjusted				
Variable Index – Surgeon Dissatisfaction	2.04	1.65-2.52	<0.001	Overwhelming evidence
Adjusted				

Variable Index – Surgeon Dissatisfaction	1.41	1.08-1.83	0.010	Some evidence
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Strong outcome predictors were Skin incision to calf removal - Duration, Variable Index – Uterus, Paravertebral, Variable Index – Surgeon Dissatisfaction, Uterus Exteriorize, Productive Type, Lactation number – Categories, Dam Position, Hysterotomy – Oversewn, Number of Calves.

Table S5: Table summarizing additional data mining, by investigating possible associations between some of the strong variables of this model. The events took place over a 2-year study period (Nov 2013 – Oct 2015), The analysis is based on multi-level mixed effects regression with vet nested within practice as random effect.

Productive Type

There was strong evidence (P = 0.006) that fewer dairy dams were primiparous (328 or 51.3% of all dairy dams) and more were Lactation 3 or more (218 or 34.1% of all dairy dams), than their beef primiparous dams (1,253 or 55.3% of all beef dams) and their Lactation 3 or more equivalents (628 or 27.7% of all beef dams).

There was overwhelming evidence (P <0.001) that fewer dairy dams had an up to 15 min duration for the laparotomy to calf removal surgical segment (495 or 77.5% of all dairy dams) and more had between 31 and 45 min duration segment (15 or 2.35% of all dairy dams), than their beef dam equivalent segments (1,921 or 84.8% of all beef dams and 33 or 1.46% of all beef dams), respectively.

There was overwhelming evidence ($P < 0.001$) that fewer dairy dams were standing during surgery (424 or 66.35% of all dairy dams) than there were beef dams standing during surgery (1,802 or 79.6% of all beef dams).

There was strong evidence ($P = 0.001$) that fewer dairy dams were anaesthetised with paravertebral anaesthesia (13 or 2.0% of all dairy dams), than their beef dam equivalents (113 or 5.0% of all beef dams).

There was strong evidence ($P = 0.003$) that fewer dairy dams had their uterus exteriorized for the hysterotomy (482 or 75.6% of all dairy dams) than their beef equivalents (1,834 or 81.0% of all beef dams).

Lactation Number – Categories

There was overwhelming evidence ($P < 0.001$) that the incidence of twin pregnancies in enrolled dams increased with lactation number. For example, 7 or 0.4% of all primiparous dams had twins, 5 or 1.0% of all dams in second parity had twins, and 27 or 3.2% of all dams in third or higher parity had twins.

There was overwhelming evidence ($P < 0.001$) that most dams were standing during surgery, irrespective of lactation number. In specific, 1,160 or 73.4% of all primiparous dams, 397 or 83.2% of all second parity, and 669 or 79.1% of all dams in third or higher parity were standing during surgery.

There was overwhelming evidence ($P < 0.001$) that the overall condition of the uterus during surgery decreased with the dam's lactation number. For instance, 900 or 56.9% of all primiparous dams, 256 or 53.7% of all second parity and 390 or 46.1% of all dams in third or higher parity were in grade 0 (normal uterus), whereas 681 or 43.1% of all primiparous dams, 221 or 46.3% of all second parity and 456 or 53.9% of all dams in third or higher parity were in grades 1 – 5 (low to highest level of uterine damage).

Number of Calves

There was overwhelming evidence ($P < 0.001$) that the duration of the surgery increased as the incidence of twin pregnancy increased. For example, 2,387 or 83.3% of all singleton CS took 15 min or less from laparotomic incision to calf removal, whereas only 29 or 74.4% of all twin pregnancies took 15 min or less for the same segment.

There was strong evidence ($P = 0.001$) that fewer singleton dams had their hysterotomies oversewn (120 or 4.2% of all singleton dam), than their twin-dam equivalents (6 or 15.4% of all twin dams).

Skin incision to calf removal - Duration

There was overwhelming evidence ($P < 0.001$) that the duration of the surgery decreased if the dam was standing. In specific, 1,918 or 79.4% of all dams that took 15 min or less for the segment between laparotomic incision and calf removal were standing, whereas that was reduced to 10 or 55.6% of all dams in the 46-60 min segment that were standing.

There was overwhelming evidence ($P < 0.001$) of an inverse relationship between the duration of the surgery and the overall condition of the uterus. In effect, 33 or 1.4% of all dams that took 15 min or less for the segment between laparotomic incision and the calf removal were in grade 5 (highest level of uterine damage), whereas that was increased to 3 or 16.7% of all dams in the 46-60 min segment were in grade 5 (highest level of uterine damage).

There was overwhelming evidence ($P < 0.001$) of a direct relationship between the duration of the surgery and the surgeon's dissatisfaction index. There was increasing surgeon's dissatisfaction with longer procedures. For instance, 118 or 4.90% of all surgeries that took 15 min or less for the segment between laparotomic incision and calf removal were in grade 2 (highest level of dissatisfaction), whereas that was increased to 9

or 50% of all surgeries in the 46-60 min segment that were grade 2 (highest level of dissatisfaction).

Dam Position

There was overwhelming evidence ($P < 0.001$) the overall condition of the uterus during the operation improved if the dam stood during surgery. For instance, 1,192 or 53.6% of all dams that were standing and 149 or 48.4% of all dams that were lying down were assessed to be in grade 0 (normal uterus), whereas 1,034 or 46.4% of all dams that were standing and 159 or 51.6% of all dams that were lying down were assessed to be in grades 1 – 5 (low to highest level of uterine damage).

There was overwhelming evidence ($P < 0.001$) that fewer dams that were recumbent during the operation had received paravertebral anaesthesia (64 or 20.8% of all recumbent dams), than their standing counterparts that received paravertebral anaesthesia (713 or 32.0% of all standing dams).

There was overwhelming evidence ($P < 0.001$) the overall surgeon's dissatisfaction index improved if the dam stood during surgery. In specific, 2,000 or 89.8% of all dams that were standing and 217 or 70.4% of all dams that were lying down were in grade 0 (lowest level of dissatisfaction), whereas 86 or 3.9% of all dams that were standing and 41 or 13.3% of all dams that were lying down were in grade 2 (highest level of dissatisfaction).

Paravertebral

There was overwhelming evidence ($P < 0.001$) that most of the dams that received paravertebral anaesthesia were not oversewn (867 or 31.21% of all non-oversewn dams), than their oversewn equivalents that received paravertebral anaesthesia (17 or 13.49% of all oversewn dams).

There was overwhelming evidence ($P < 0.001$) that a larger percentage of dams that had paravertebral anaesthesia had uterine variable index 4 (33 or 47.8% of all score 4 dams), whereas a smaller percentage of dams that had paravertebral anaesthesia had uterine variable index 0 (370 or 23.9% of all score 0 dams).

Variable Index – Uterus

There was overwhelming evidence ($P < 0.001$) that the surgeon became more dissatisfied as the condition of the uterus deteriorated. In effect, 48 or 3.1% of all operations assessed to be at uterine index grade 0 (lowest level of uterine damage) and dissatisfaction grade 2 (highest level of dissatisfaction), whereas 18 or 43.9% of all operations assessed to be at uterine index grade 5 (highest level of uterine damage) and dissatisfaction grade 2 (highest level of dissatisfaction).
