



Managing Culling in Dairy Herds: One Cow at a Time



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Why the recent interest in culling?

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"Cows need to last 5 lactations!"

(mean herd turnover rate would be 20%)

(on average)

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Longer productive lives improve environmental footprint



Culling rate (%)	Age at first calving (mo)			
	22	24	26	28
	No. of replacements needed per 100 cows ¹			
25	54	59	64	69
30	65	71	76	82
35	75	82	89	96
40	86	94	102	110
	— Replacement contributions to whole-herd enteric CH ₄ ² (%) —			
25	19.6	21.0	22.4	23.7
30	22.7	24.2	25.7	27.2
35	25.5	27.2	28.8	30.3
40	28.1	29.9	31.6	33.2

Range
20-33%
of herd
methane
emissions

¹Calculated based on NRC (1998), based on 10% culling and mortality, and 10% heifers born dead on arrival and 10% culling and mortality.
²Calculated based on NRC (2001), based on 10% culling and mortality, and 10% heifers born dead on arrival and 10% culling and mortality, and according to NRC (2001); and methane production = 5.6% gross on lactating mature cows, and 8.0% for replacement heifers.

Potential for ~ 6%
improvement with
lower turnover rate

From Knapp et al., J Dairy Sci 97:3231, 2014

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Key Performance Indicator Percentiles

(Data from herds recorded by AgSource Cooperative Services)



Monitor	2012 (n=3421)			2022 (n=1693)			Net Top 20%
	80th	50th	20th	80th	50th	20th	
Daily Milk lb	57	69	80	64	77	89	+9
% Fat	3.6	3.8	3.8	3.8	4.0	4.2	+0.4
% Protein	3.0	3.1	3.1	3.1	3.2	3.2	+0.1
Average DIM days	208	187	162	195	179	158	-4
Age at First Calving mo	28	26	24	27	26	23	-1
Pregnancy Rate %	7	12	18	13	20	27	+9
Turnover rate (less dairy sales) %	44	36	27	44	36	27	0
Weighted Average SCC '000/ml	341	263	159	263	198	118	-41
Average Days Dry	68	61	51	66	60	52	+1
Transition Cow Index® lb	-760	-17	+716	-376	+339	+1103	+387
Turnover rate less than 60DIM %	11	7	4	10	7	4	0

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Cluster Analysis of DHI data from 557 Freestall Housed Dairy Herds

(Brotzman et al., J Dairy Sci 98:3059, 2015)



DHI Variable	Group 1 (n = 171)	Group 2 (n = 86)	Group 3 (n = 97)	Group 4 (n = 67)	Group 5 (n = 62)	Group 6 (n = 74)
Herd size, cows, lowest - highest	493 ^b	270 ^e	365 ^{cd}	270 ^{de}	403 ^{bc}	1097 ^a
Milking freq., lowest - highest	3.0 ^a	2.0 ^d	2.9 ^a	2.2 ^c	2.8 ^b	3.0 ^a
% 1 st Lactation, lowest - highest	38.4 ^b	38.1 ^b	38.6 ^b	38.0 ^b	37.8 ^b	43.8 ^a
Energy Corrected Milk, lb	93 ^a	87 ^b	88 ^{ab}	75 ^d	81 ^c	89 ^{ab}
Days In Milk	182.9 ^c	179.7 ^c	195.5 ^a	189.1 ^b	192.5 ^{ab}	181.8 ^c
Days Dry	59.4 ^{ab}	59.4 ^{ab}	54.7 ^c	60.7 ^a	60.8 ^a	57.0 ^{bc}
Age at 1 st Calving	24.1 ^d	24.5 ^{dc}	25.3 ^{ab}	25.6 ^a	24.9 ^{bc}	23.4 ^e
Transition Cow Index, lb	458 ^a	520 ^a	-24 ^b	-377 ^c	-469 ^c	-31 ^b
Milk Peak Ratio	74.4 ^c	74.1 ^c	77.8 ^a	77.6 ^a	76.4 ^{ab}	74.9 ^{bc}
Linear Somatic Cell Score	2.2 ^d	2.3 ^d	2.6 ^c	3.0 ^a	2.8 ^b	2.7 ^c
% New Udder Infections	8.7 ^c	8.9 ^c	11.9 ^b	14.7 ^a	13.9 ^a	12.6 ^b
% Udder Infections 1 st test	11.0 ^e	13.7 ^d	15.7 ^c	19.9 ^a	17.8 ^b	14.5 ^{cd}
% Dry Period Infection Cures	75.5 ^a	66.4 ^b	63.9 ^b	56.5 ^c	63.7 ^b	71.5 ^a
% Turnover Rate, Non-dairy	33.5 ^b	36.1 ^b	35.9 ^b	32.6 ^b	40.0 ^a	43.0 ^a
% Cows Died	5.7 ^{cd}	5.7 ^{cd}	6.3 ^{bc}	4.9 ^d	12.4 ^a	7.6 ^b
% Cows Died by 60 DIM	2.3 ^{bc}	2.7 ^b	2.4 ^{bc}	1.8 ^c	5.7 ^a	2.7 ^b

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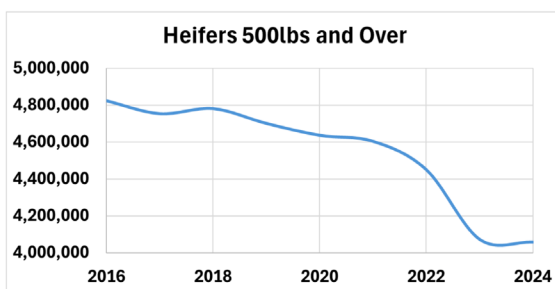
Improved longevity is goodrrrrright?

- The association between longer lives and better welfare is less than clear **at the herd level**
- The positive impact on environmental GHG emissions is **modest at best**, and insignificant compared to improvements in milk per cow
- There is great **herd variation in time to break even** for heifer rearing costs, which are poorly tracked anyway!
- Despite economic models suggesting that 20% culling rate is optimal, farmers in the US maintain turnover rate averages of ~ 36% and have refused to change them despite huge improvements in other performance metrics driven by genomics, nutrition and cow comfort

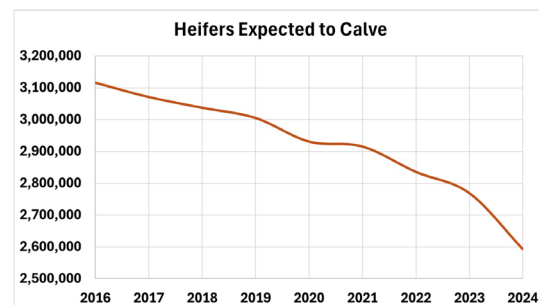
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Maybe this is all about to change Replacement Supply



Adapted from USDA National Agricultural Statistics Service (NASS) data. Accessed January 31, 2024.



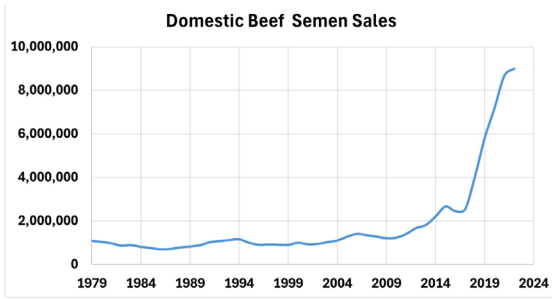
Adapted from USDA NASS data. Accessed January 31, 2024.

USDA NASS Data

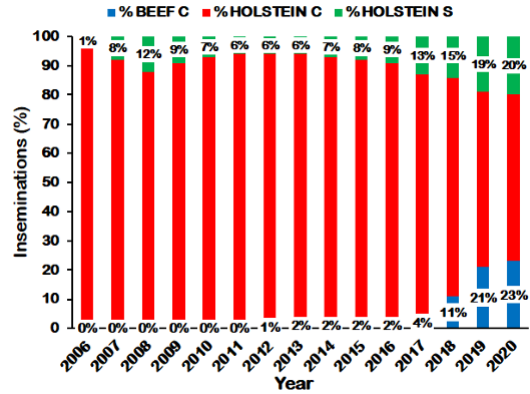
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Sexed Holstein and Beef Semen Utilization



Adapted from National Association of Animal Breeders (NAAB) data. Accessed January 31, 2024.



M.R. Lauber and P.M. Fricke

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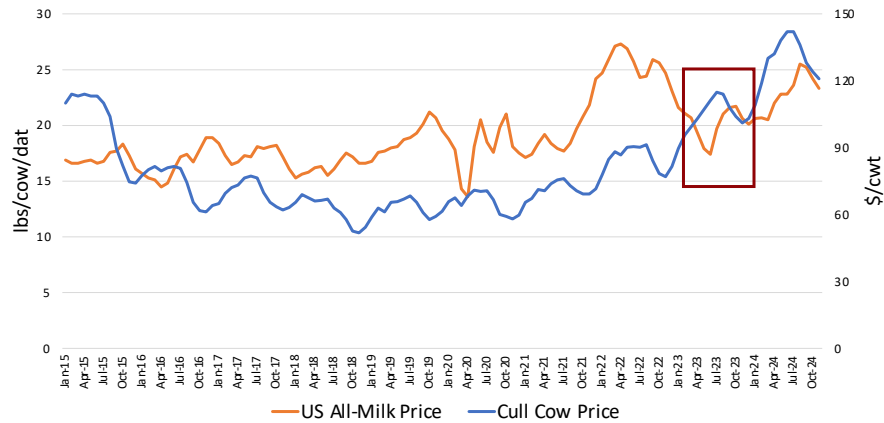
We decided to ask farmers what challenges they face selecting cows for removal from the herd and why cows left



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Cull Cow & Milk Price Markets



USDA NASS Data

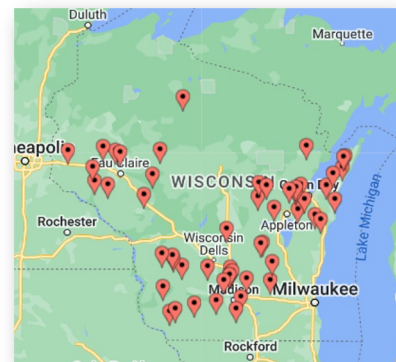
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Selected Herds

Visited 60 freestall-housed Wisconsin dairy herds

- Predominant breed: **Holstein (91%)**
- Average herd size: **1,334 cows** (101-5414)
- Mean milk production: **93lbs/cow/day**
- Milking frequency: **83% of herds milking 3x**
- Mean turnover rate: **33% of herd** (25-47%)
- Mean death rate: **5% of herd** (2-11%)
- **79% of herds used deep bedding**
 - 45% fresh sand, 25% recycled sand, 21% mattress
- Records management system:
 - **DairyComp 305: 46 farms (77%)**



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How are cows culled?

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Culling Process

Culling Frequency

As Needed:
69% of herds

Fixed Interval:
31% of herds

Use of Reports

Individual cow record:
96% of herds

Designated report:
50% of herds

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What would help you choose a cow to be culled?

1. **Good records** 57%
2. **Economic value (but not COWVAL!)** 29%
3. **Genomics data** 5%
4. **Automated flags to ID cows for culling** 5%
5. **Lifetime production data** 4%



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Herd Culling Reports



Common Parameters

- Milk
- Repro status
- SCC

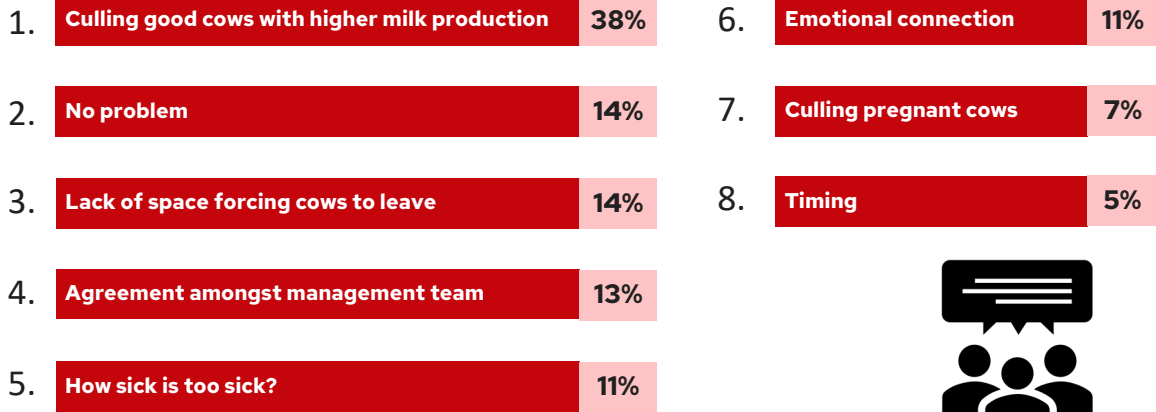
DairyComp 305
 Command : POSCULL
 Early Dry Off or Cull Candidates
 Page 1
 07/20/23 10:32 AM

ID	LACT	DIM	PEN	MILK	MKDEV	305PR	RELV	SCC	DUE	RPRO	3TEAT	SI
6696	4	381	2	48	-10	35210	111	93	11/16/23	PREG		0
6481	5	319	3	50	-2	25320	80	162	10/19/23	PREG		1
7308	3	365	1	50	-15	37870	120	38	9/15/23	PREG		0
4840	8	328	3	56	-21	39060	123	19		NO BRED		0
7380	3	383	2	56	0	34920	110	162	10/ 5/23	PREG		0
7746	2	432	8	56	-6	41070	130	57		NO BRED		0
8025	1	588	8	56	0	35570	112	87		NO BRED		0
8033	1	589	8	56	-7	32310	102	66		NO BRED		0
8514	1	163	7	56	-15	21550	68	13	2/18/24	PREG		0

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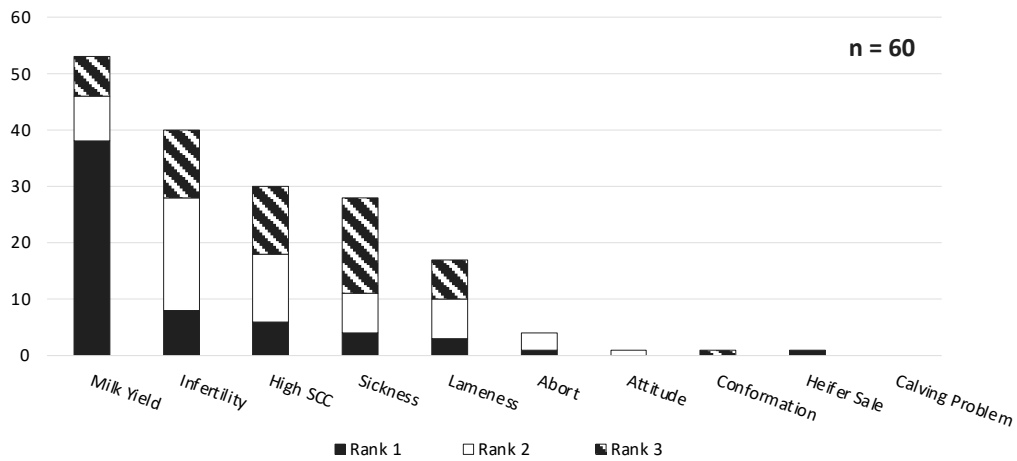
What do you find most challenging about deciding when to cull a cow?



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Ranked Culling Reasons



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Survey Conclusions



- The culling process is not standardized and varies greatly by farm – often culling **'one cow at a time'**
- Producers value quality cow records, but may not know how to fully utilize them to summarize data
- When used, summary reports are limited in scope: focus is on **'what have you done for me lately'**

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Why are cows culled?



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Farms should be held accountable to the **quality** of the animals leaving the herd, not the **quantity**

Removal reasons might provide a good starting point to explore the *quality* ...



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- **Farms:** 46 DC305 recorded farms from survey
- **Data source:** Consultant backup files from DC305 & manually recorded CAR codes
- **Inclusion criteria:** Cows with a "SOLD" or "DIED" event within the last 4 years (1461 days)
- **Health data processing:**
 - Duplicate health events filtered using preset interval gaps

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• Culling classification:

- Each culled cow was manually assigned a primary culling reason
 - Secondary reason assigned when available
 - Based on individual review of each cow's CAR codes and the culling remark provided in DC305

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Disposal Codes (CAR)

- Standard DHIA codes are used in DC305 setup ('the standard 8')
- DC305 used as common interface between DHIA and farm-collected data
- AgSource Cooperative Services DHI in WI uses different codes (21-29)
 - Injury used as a default code (24) when reason is unknown..

National DHIA Codes

1	Any sickness
2	Sold -- dairy
3	Sold -- low productivity
4	Sold -- breeding
5	Sold -- injury, sick
6	Died
7	Sold -- mastitis
8	Abort
9	Record not to be used
0	

21	Sold -- Dairy
22	Sold -- Low Production
23	Sold -- Reproduction
24	Sold -- Injury
25	Sold -- Mastitis, udder
26	Died
27	Sold -- Feet, Leg Probl
28	Sold -- Disposition
29	Sold -- Calf sold/died

AgSource DHI Codes

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Disposal Code Discrepancies

- Herds can change their disposal code reason on farm in DC305 setup
- Codes are NOT transferrable in consultant backup (have to collect them at the farm computer)

DHIA Codes

1 Any sickness	1 SOLD--SICK	1 Sold Dairy	1 Metabolic Problems
2 Sold -- dairy	2 Sold -- low prod due to	2 Sold Production	2 Miscellaneous
3 Sold -- low productivity	3 Sold -- MILK OFF/LOW PR	3 Sold Reproduction	3 Low Production
4 Sold -- breeding	4 Sold--Breeding Cyst-Adh	4 Sold Injury, Disease	4 Rebro, not bred
5 Sold -- injury, sick	5 Sold -- injury	5 Sold Mastitis, Udder	5 Injury
6 Died	6 DIED	6 Died	6 Died
7 Sold -- mastitis	7 Sold -- mastitis	7 Sold Feet and Leg	7 Mastitis
8 Abort	8 SOLD--ABORT	8 Sold Disposition	8 Abort >100 Days
9 Record not to be used	9 SOLD--FEET	9 Record not to be used	9 Age
0	10 SOLD--LEGS	10 Sold Ketosis	10 Days to Calve
	11 SOLD--JOHNIES	11 Sold DA	11 Feet & Leg Problems
	12 SOLD--HIP	12 Sold Dead Calf	12 Udder Problems
	13 DIED--PARATINITIS	13 Sold Calf	13 Respiratory
	14 sold--udder&teat shape	14 Abort	14 Calving Injury
	15 sold--intestinal or int	15	15 Room
	16 sold--ulcer	16	16 Dairy

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Disposal Reasons – SOLD/DIED Remarks

Events	Items1	Items2	TestDays	PrevLacts	Lactation
ID	16717	LACT	6	MKDAT	7/24/20 BNAME 16717
PEN	12	DCC	0	BFDAT	5/ 7/22 BADBG -
MAVG	0	DIM	188	DUE	- ETDNA -
GBPI	2066	GDWP\$	215	RV	100 RPRO SLD/DIE
06/10/22	FRESH	8		Bull Live Tech: 42 Miguel	09/26/22 OPEN
06/12/22	WEIGHT	1745			09/26/22 DNB SCAREDUT
06/13/22	MOVE	F029T027			11/15/22 MOVE F021T005
06/28/22	MOVE	F027T026			11/25/22 MOVE F005T012
07/19/22	MOVE	F026T021			11/27/22 CULTURE G+ Cult G+
08/08/22	MOVE	F021T012			11/27/22 MAST MIRR..NT Mastitis NT
08/11/22	CULTURE	ST		Cult Staph	11/28/22 CULTURE ST Cult Staph
08/11/22	MAST	MILF..NT		Mastitis NT	11/28/22 MAST MILFRNT Mastitis NT
08/11/22	MOVE	F012T021			12/02/22 MOVE F005T012
08/11/22	DIHOSP	3			12/03/22 SCCWORK CALFMILK calfmilk
08/25/22	BRED	7AN606	0	42 R	12/15/22 SOLD DXMAST

SOLD/DIED Event Remark = 8 characters

Our favorite culling remarks:

CRAZY
TAGEATER
EVIL
BITCH
OLDAF
RETIRED
HOTMESS
LEGSUGLY
STUPID

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Disposal Code Discrepancies

Our study found that 25% of stated reasons did not match the given CAR code

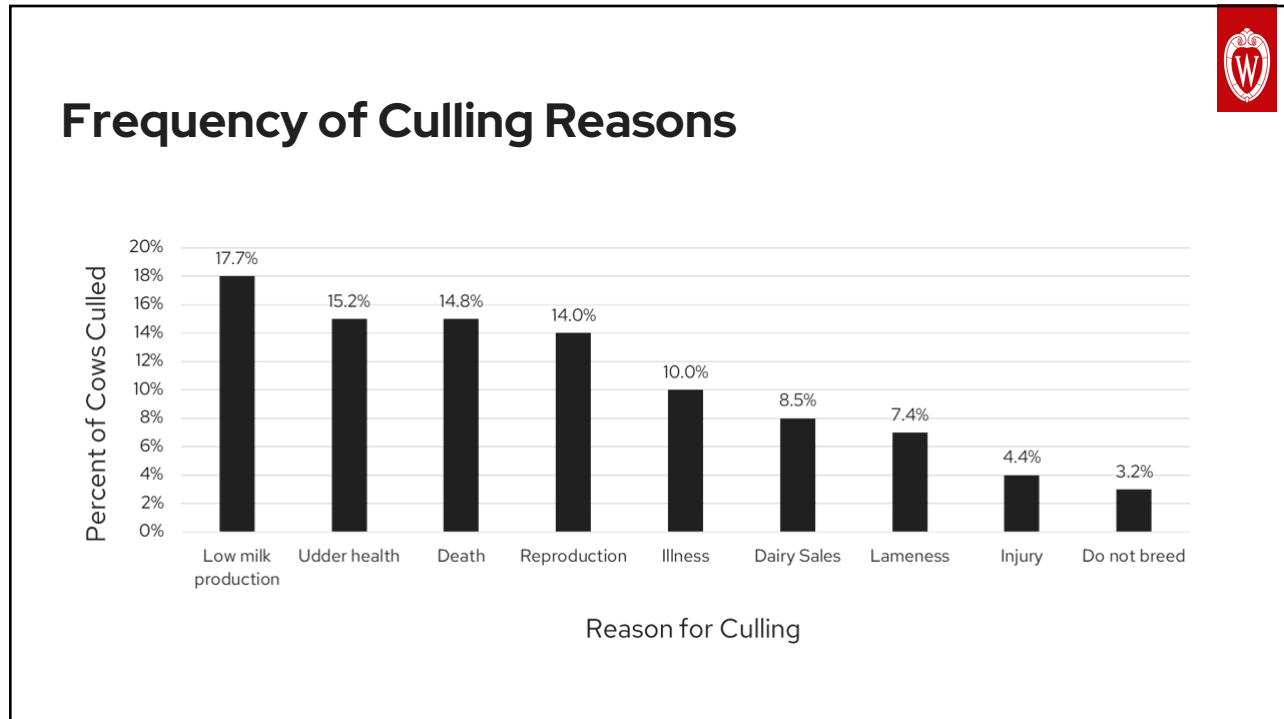
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Cull Cow Demographics

- **85,768 cows** culled from 46 farms over a 4-year period
 - 73,111 cows sold
 - 12,657 cows died
- Herd mean annual turnover rate: **36.0 (8.1)%**
 - 32.8 (6.1)% less dairy sales
 - Mean death rate: 5.2 (2.0)%
- Culling by lactation
 - 26% 1st lactation
 - 23% 2nd lactation
 - 20% 3rd lactation
 - 15% 4th lactation
 - 16% 5th+ lactation

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Culling Reasons

Our study found **low milk production, udder health, death, reproduction and illness** to be the most frequent culling reasons.

Culling reason studies utilizing DHIA data found:

- Pinedo et al. (2,054 herds)
 1. Reproduction
 - 2. Injury**
 3. Production
- Hadley et al. (20,132 herds)
 - 1. Injury**
 2. Reproduction
 3. Production

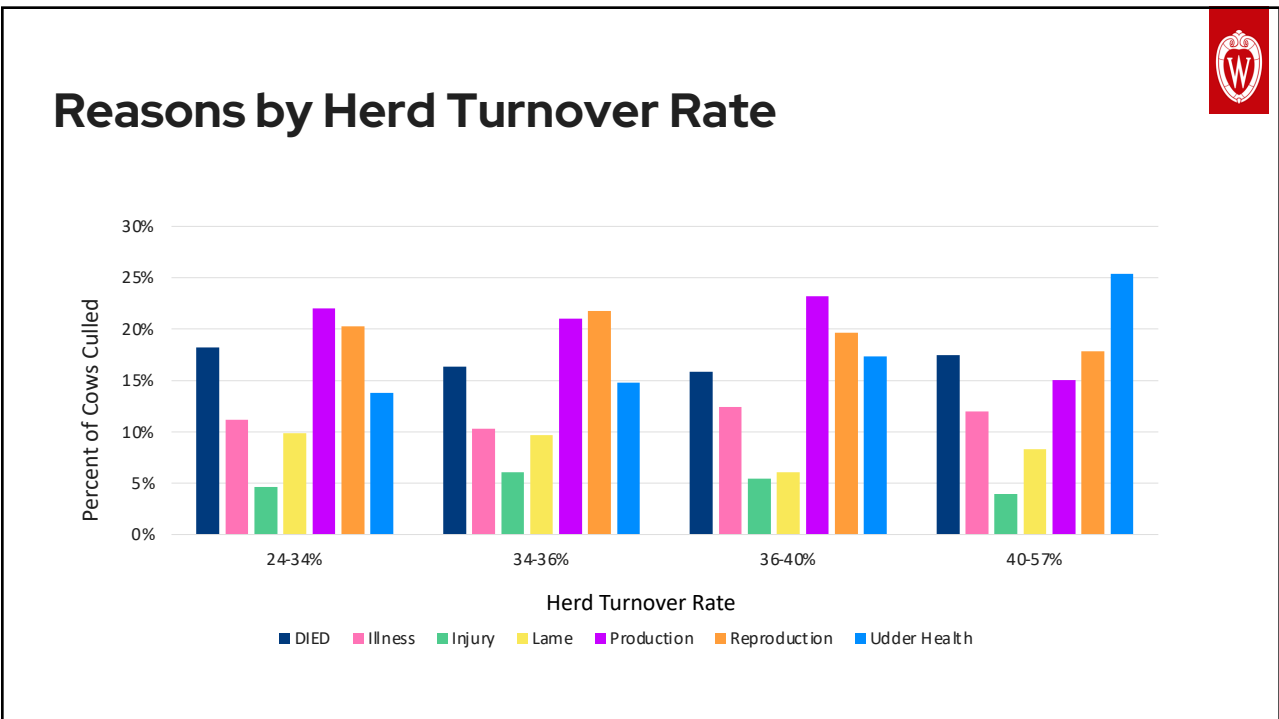
Reminder: Injury is a default DHIA code....

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Examination of Culling Reasons - Trends

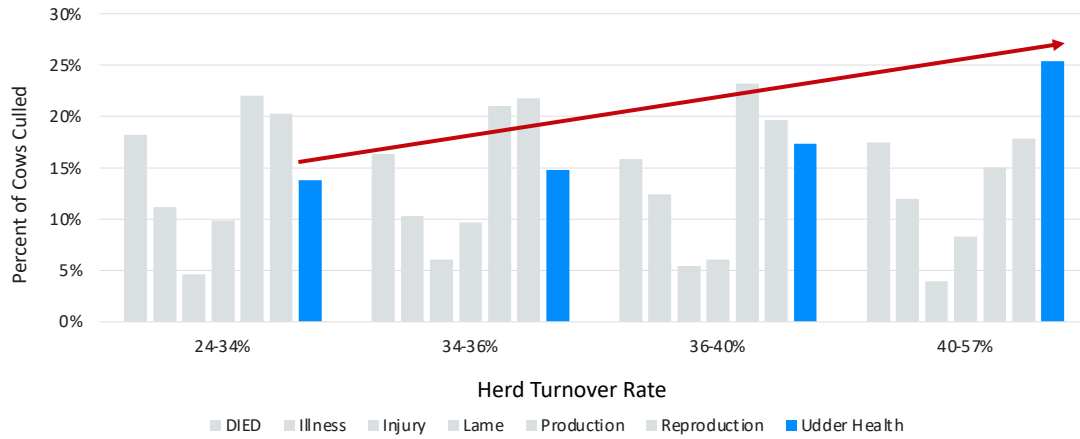
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Reasons by Herd Turnover Rate



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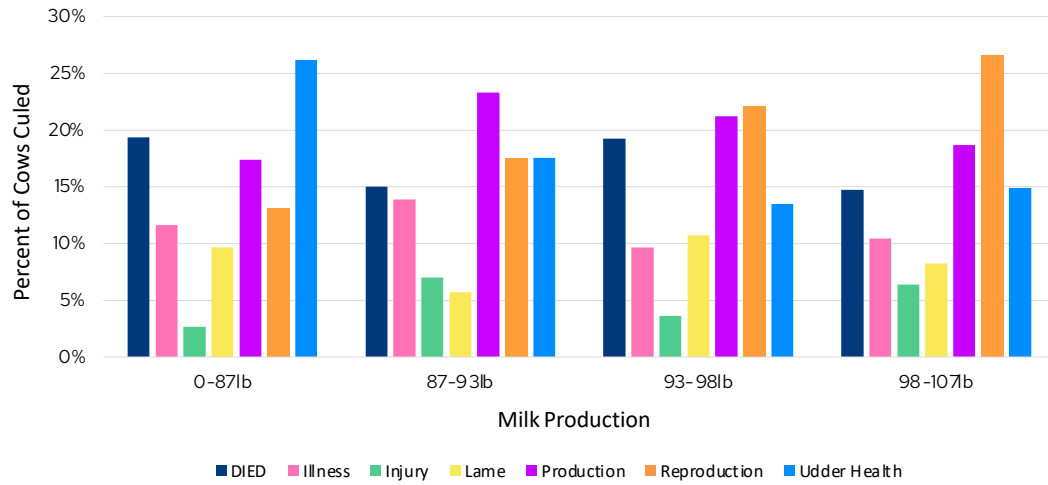
Reasons by Herd Turnover Rate



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Reasons by Herd Milk Production



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Low Production Herds



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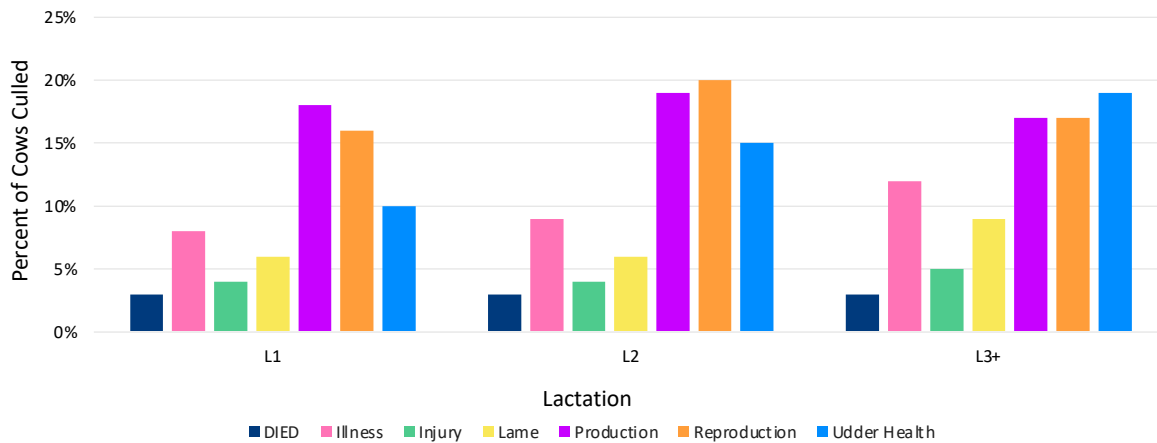
Reasons by Herd Milk Production



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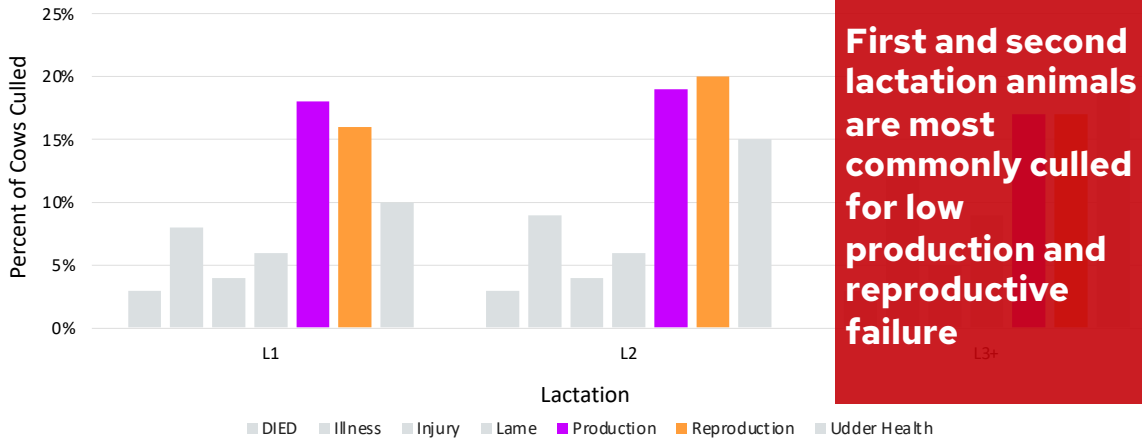
Reasons by Lactation



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First and Second Lactation Culls



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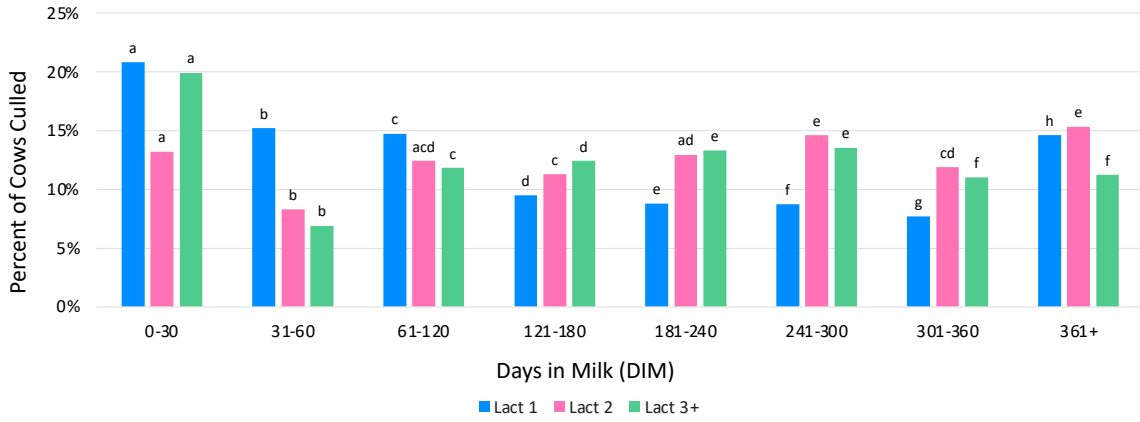
Third Lactation Culls



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Culling by Lactation by DIM

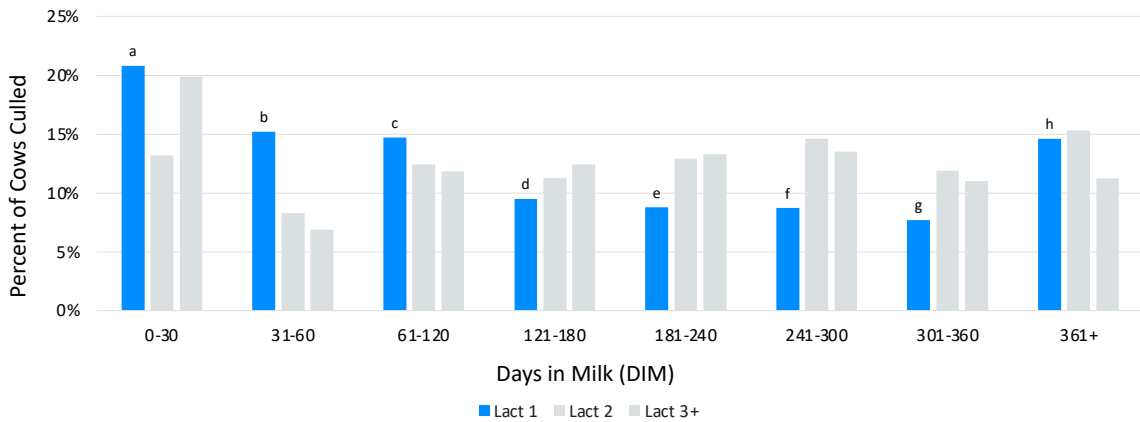


Different superscripts indicate statistically significant difference between DIM groups within lactation group (P<0.05, Bonferroni-adjusted).

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First Lactation Culls by DIM



Different superscripts indicate statistically significant difference between DIM groups within lactation group (P<0.05, Bonferroni-adjusted).

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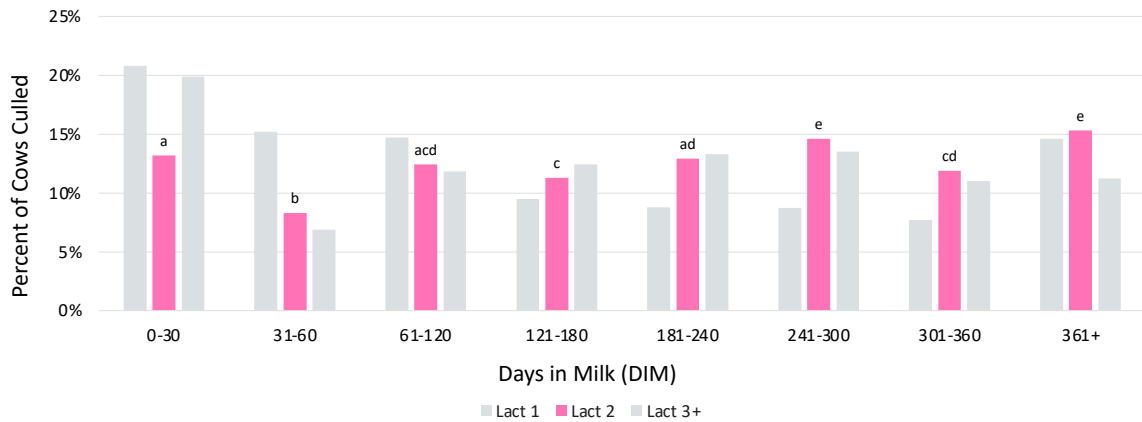
First Lactation Culls by DIM

- The highest number of culls were observed in early lactation
 - (0-30 days in milk (DIM))
- **28%** of first lactation culls in the first 30 DIM were attributed to dairy sales
 - **19%** of cows died
 - **13%** of cows left due to udder health issues
 - **11%** of cows left due to illness

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Second Lactation Culls by DIM



Different superscripts indicate statistically significant difference between DIM groups within lactation group (P < 0.05, Bonferroni-adjusted).

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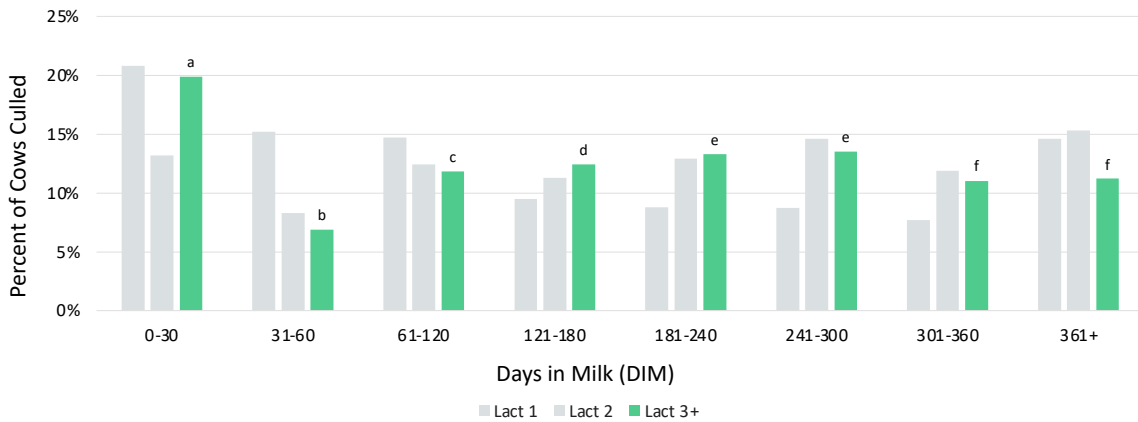
Second Lactation Culls by DIM

- The highest number of culls were observed in late lactation
 - 301+ DIM
- **25%** of second lactation culls in the first 30 DIM were attributed to deaths
 - **17%** of cows left due to illness
 - **15%** of cows were sold to another dairy
 - **12%** of cows experienced reproductive failure

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Third + Lactation Culls by DIM



Different superscripts indicate statistically significant difference between DIM groups within lactation group (P<0.05, Bonferroni-adjusted).

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Third Lactation Culls by DIM

- The highest number of culls were observed in early lactation
 - (0-30 days in milk (DIM))

Across all parities, death (29%) and illness (19%) were the most common reasons for cows leaving in the first 30 DIM

- 24% of cows left due to illness
 - 11% of cows left due to udder health issues
- 8% of cows experienced reproductive failure

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Characteristics of Culled Cows by Culling Reason

—

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Low Production Culls

- Most prominent removal reason (**18% of culls**)
 - Reflects current status of cow, but not the causative reason
- Lowest mean (SD) daily milk yield: **59.8 (22.0) lbs/cow/day**
- **28% pregnant** at time of removal
- **47% had a recorded health event** in the current lactation

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When there are multiple reasons, how do you pick a reason to record why the cow is culled?



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Are They All Low Production Culls?

- **69%** of production culls classified as “true” production culls
 - Lower than herd average current milk
 - Lower than herd average ME305
- **26%** of production culls classified as “acute” production culls
 - Lower than herd average current milk
 - **Above herd average ME305**
 - **Health related?**

Some low production culls are actually higher producing cows with low current milk!

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Udder Health and Teat Culls

- Second most common removal reason (**15% of culls**)
 - Highlights challenges herds face in maintain low SCC and high milk quality
- Highest mean (SD) log linear score: **3.2 (2.3)**
- Teat removals had highest mean (SD) daily milk yield at removal: **87.3 (33.3) lbs/cow/day**
- **33% pregnant** at time of removal!
- **54% had a recorded mastitis event** in the current lactation
 - Higher levels of recording likely driven by use and need for documentation of antimicrobial therapy

Most prominent in older cows and in herds with highest turnover rate, and lowest milk production – representing herds struggling to maintain high milk quality

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Deaths



- Third most common removal reason (**15% of culls**)
 - Many studies do not report death as a primary removal reason
 - US death rates are typically higher than in European herds
- Second highest mean (SD) daily milk yield at removal: **86.4 (34.4) lbs/cow/day**
- **35% pregnant** at time of removal (second highest pregnancy rate)
- Deaths are the most common removal reason in early lactation (0-30 DIM)

Characteristics would suggest that death is sudden in nature, in previously high producing cows perhaps linked to unidentified illness?

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Reproduction and DNB Culls



- Cows culled for reproduction and do not breed (DNB) had significantly longer mean days in milk
 - **309.0** (157.3) and **330.5** (133.4) days respectively
- Significantly extended open periods: **284.7** (163.7) and **328.1** (135.2) days
- Higher number of breedings: **3.2 (2.3)**
- Lowest frequency of pregnancy: **12%**

Increased as herd milk production increased!

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Illness Culls

- **10% of culls**
- Most common secondary reason is **respiratory disease (27%)**
- **44.2%** of illness culls experienced **at least one health event** in the lactation of removal

Less than half of cows culled for illness had a recorded illness event in the lactation of removal, suggesting an opportunity for better record-keeping of health events

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A Note On Pregnancy

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Pregnant Cull Cows

- **26%** of cows culled were pregnant at the time of removal
 - Consistent with literature:
 - 23.5% pregnant in UK (Singleton and Dobson)
- Majority of breeding in these herds was done by artificial insemination (AI)
- Suspected interaction between milk price, cull price, and willingness to cull pregnant cows

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Proportion Pregnant by Reason

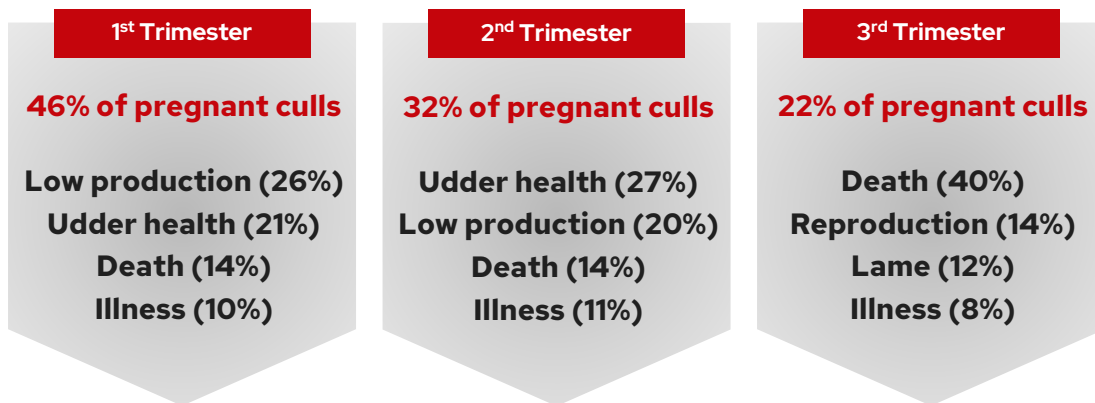
	# Pregnant Cows	Total # Cows	Percent Pregnant
Dairy Sale	851	7280	11.7% ^a
Died	4396	12657	34.7% ^{bc}
Illness	2193	8553	25.6% ^b
Injury	1114	3743	29.8% ^b
Lame	2246	6326	35.5% ^{bc}
Other	994	3970	25.0% ^b
Production	4372	15143	28.9% ^b
Reproduction	1489	14805	10.1% ^b
Udder Health	4435	13287	33.4% ^c

Different superscripts within column indicate statistical significant pairwise differences between proportion of pregnant cows ($P < 0.05$, Bonferroni-adjusted).

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Culling Reasons by Trimester of Pregnancy



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Health Events & Culling Reason

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Health Events by Culling Reason

	Current Lactation Health Events			
	1 or more Events	1 Event	2 Events	3+ Events
Death n=12657	39.2% ^a	27.9% ^a	8.9% ^a	2.4% ^a
Dairy Sale n=7281	16.9% ^e	12.9% ^e	3.2% ^e	0.8% ^d
Illness n=8553	44.2% ^b	30.7% ^{bc}	10.6% ^{bc}	2.8% ^{ab}
Injury n=3743	34.8% ^d	23.8% ^d	8.3% ^a	2.7% ^{ab}
Lame n=6326	41.4% ^{ac}	29.2% ^{ac}	9.3% ^{abc}	2.9% ^{ab}
Other n=3970	39.9% ^{ac}	28.3% ^{ac}	9.2% ^{abc}	2.3% ^{ac}
Production n=15143	46.1% ^b	31.5% ^b	11.2% ^b	3.4% ^b
Reproduction n=14805	40.1% ^{ac}	27.4% ^a	9.4% ^{ac}	3.3% ^{bc}
Udder Health n=13287	62.8% ^f	45.6% ^f	13.0% ^f	4.2% ^e

Different superscripts within columns indicate statistical significance of pairwise differences between proportion of pregnant cows across culling reason ($P < 0.05$, Bonferroni-adjusted).

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Health Events

- Of the cows in the dataset, **44% experienced at least one health event** during the lactation of removal
 - Suggests that poor health plays an important role in culling decisions
- Lameness and mastitis had a shorter median interval between health event and removal (47-61 days) compared to other health events (110-173 days)

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Conclusions

- Farmers cull one cow at a time
 - Process not standardized
 - Limited use of short-term records
 - Records not fully utilized in organized reports
- Most cows leave for production, udder health, death, reproduction & illness
 - Production & reproduction consistent with DHI data
 - Discrepancy with CAR codes
- 26% of cows are pregnant at the time of removal!
- Death and illness were the most common reasons for leaving in the first 30 DIM
- First and third lactation culls are most prevalent in the first 30 DIM
 - First lactation: dairy sales
 - Third lactation: death
- 44% of culled cows experienced at least one health event in the lactation prior to removal

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Conclusions - Reasons



- Production culls
 - 69% true
 - 26% good cows with low current milk
 - 47% experienced a health event
- Udder health
 - 33% pregnant
 - 54% mastitis
 - Higher proportion in high turnover rate herds and low-producing herds
 - Higher proportion of older cows
- Deaths
 - High pregnancy rate (36%)
 - Prevalent in first 30 DIM
 - Higher milk yield
 - Acute, sudden nature
- Reproduction
 - Low proportion pregnant, high TBRD, long days open
 - Increase as herd milk increases
- Illness
 - Most common secondary reason was respiratory disease
 - 44.2% experienced health event in lactation of removal

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Future Directions



- Standardized DC305 culling report
- Development of an on-farm decision-making tool utilizing production, **health**, and reproduction data to help farmers decide which cow to cull BEFORE they breed her!

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Suggested DC305 Report

LIST ID LACT DIM DCC TBRD MILK ME305 MKDEV RELV DRYLG SCC XMAST XLAME XRP XMETR FOR MILK>0 BY MILK\U

ID	LACT	DIM	DCC	TBRD	MILK	ME305	MKDEV	RELV	DRYLG	SCC	XMAST	XLAME	XRP	XMETR
4497	4	15	0	0	27	0	14	0	1.4	1381	0	0	0	0
5027	2	472	223	5	35	41120	-14	120	3.2	116	0	0	0	0
7047	1	16	0	0	35	0	18	0	0	510	0	0	0	0
7163	1	15	0	0	35	0	18	0	0	284	0	0	2	0
4696	3	383	195	4	41	37870	-12	116	1.5	321	0	0	0	0
7187	1	15	0	0	41	0	21	0	0	163	0	0	0	0
7124	1	15	0	0	44	0	22	0	0	485	0	0	0	0
2433	5	383	223	2	47	34870	-15	105	3.4	130	0	0	0	0
5673	2	355	230	2	47	33860	-8	101	3.4	139	0	0	1	0
3510	4	312	237	1	50	35850	-9	106	3.0	98	0	1	0	0
6195	2	15	0	0	53	0	27	0	0.1	437	0	0	0	0
6483	1	294	209	1	53	29750	1	87	0	79	0	0	0	0
7148	1	16	0	0	53	0	27	0	0	333	0	0	0	0
7209	1	17	0	0	53	0	27	0	0	230	0	0	0	0

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