Survey of U.S. cow-calf producer methods and opinions of cattle health and production record-keeping

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Abstract

The objective of this study was to describe U.S. cow-calf producer characteristics associated with the use of cattle health and production records (CHPR). We anonymously surveyed 14,294 cow-calf producer members of the National Cattlemen's Beef Association (NCBA). Multivariable logistic regression by manual forward variable selection was used to test demographic factors for association with CHPR-keeping outcomes. In total, 3,741 (26.2%) responses were received, with 3,641 (97.3%) respondents actively involved in cow-calf production. Of 3,624 respondents who said whether or not they maintained CHPR, 3,169 (87%) used some form of CHPR. Of 3,133 respondents who described their CHPR-keeping methods, 1,966 (62.8%) used handwritten, and 1,167 (37.2%) used electronic CHPR. Cows and calves were individually identified by 3,118 of 3,616 (86.2%) respondents. Annual cow inventory (96%), breeding dates (89.3%) and calving dates (88.1%) were the most commonly recorded CHPR. Among all respondents, understanding commercially available CHPR software (57.2%) was the most commonly identified CHPR-keeping challenge. Factors associated with using any form of CHPR were seedstock production (OR = 5.1, 95%C.I. = 3.6-7.3; compared to non-seedstock production), respondent age (≤ 54 years: OR = 2.5, 95%C.I. = 1.8-3.5; 55-64 years: OR = 1.7, 95%C.I. = 1.2-2.3; 65-74 years: OR = 1.3, 95%C.I. = 1.0-1.7; compared to age ≥ 75 years), female respondents (OR = 1.7, 95%C.I. = 1.2-2.5; compared to male), respondent's primary income source is cow-calf operation (OR = 1.5, 95%C.I. = 1.2-1.9; compared to not being primary income source), and respondent having a post-graduate or professional degree (OR = 1.7, 95%C.I. = 1.2-2.5; compared to high-school diploma or less). This study concluded that demographic factors such as producer age, gender, education level and operational goals impact CHPR-keeping on U.S. cow-calf operations.

Key words: beef, demographics, data, survey, records

Introduction

Cattle health and production records (CHPR) make it possible to objectively monitor cow-calf operational performance.[1–4] The utility of data documenting cattle health and performance has been recognized for decades. In the 1970s, an important step forward was taken when Integrated Resource Management (IRM) programs were formed to address systemic issues with reproduction on cow-calf operations. Record high interest rates and farm debt in the 1980s revealed the need for objective financial and production data in order for producers and financial institutions alike to make evidence-based decisions regarding operational finances.[5] Standardized Performance Analysis (SPA) programs were formed to provide uniform measurements of production in cow-calf herds, facilitating the comparison of similar operations and the identification of problem areas in cattle health and production. Efforts to assist cow-calf producers in collecting data necessary for SPA led to the development of record-keeping tools such as the Red Book, distributed through the National Cattlemen's Beef Association (NCBA) and still widely used today.[5]

Cattle health and production records are useful for evaluating individual animal performance, investigating outbreaks of disease or decreased production, and measuring the impact of management interventions.[1] Qualitative and quantitative data may be used to evaluate various metrics of production used in SPA of cow-calf or stocker operations such as calving interval, weaning weight, mature cow weight, average daily gain, feed conversion, etc.[5] Cattle health and production records may also be used to establish operational benchmarks and assist in epidemiologic investigations of morbidity and mortality, or decreased production. Lastly, efficacy of management interventions (e.g., vaccination or antimicrobial treatment protocols) can be assessed if accurate herd data is available to the producer and their veterinarian.[6–9]

The 2007-2008 United States Department of Agriculture (USDA) National Animal Health Monitoring System (NAHMS) Beef Study found that 83.3% of cow-calf producers kept some form of records, and 78.6% of those producers were using handwritten records.[10] A 2021 study found 73.6% of respondents to a survey of cow-calf producers in Mississippi kept some form of handwritten records.[11] Handwritten records (i.e., pocket notebooks, notepad, ledger books, etc.) offer producers an effective and convenient method of capturing CHPR, but are difficult to query, summarize or analyze. To be most useful, handwritten records must be converted to an electronic format (e.g., spreadsheet format) to facilitate any further analysis.[1] In the 2007-2008 USDA NAHMS Beef Study, 19.9% of U.S. cow-calf operations kept records on a computer located on or off the operation, with operations consisting of 200 or more cows representing the largest percent (37.4%) of operations keeping electronic records using an on-operation computer.[10] Reasons why U.S. cow-calf producers do not utilize electronic CHPR on their operations are not well understood; however, these reasons may include 1) lack of time required to convert handwritten records to electronic records,

2) lack of understanding of how to use current commercially available electronic record-keeping software tools, 3) no perceived advantage to electronic records over handwritten records, 4) lack of tools needed to keep electronic records (i.e., personal computer, tablet, smart-phone, etc.), or 5) no perceived financial benefit to collecting any form of CHPR.

Continual consolidation within the U.S. beef industry, as well as societal concerns for sustainable agriculture, animal traceability and antimicrobial stewardship, increases the importance of accurate and reliable CHPR on cow-calf operations. Cattle health and production data can inform decisions on operational efficiency and resource use, regardless of operation size; improved use of CHPR may also help smaller operations improve efficiency and profitability. Data describing animal health is essential to aspects of animal traceability such as monitoring and detecting disease incursions, implementing national biosecurity measures, and safeguarding food animal product supply chains.[12] Antimicrobial stewardship on-farm may be enhanced if systems of collecting CHPR are in place to provide veterinary practitioners access to treatment and outcome data that may be used to make more informed decisions on antimicrobial use.[13,14] The objective of this study was to describe the CHPR-keeping methods of U.S. cow-calf producers, and identify challenges they face in using CHPR on their operations.

Materials and methods

Sample

Beef cow-calf producers in the U.S. who are familiar with CHPR were the target population of this study. We surveyed cow-calf producer members of the National Cattlemen's Beef Association (NCBA) because the NCBA actively promotes the use of CHPR among its members through the National Beef Quality Assurance (NBQA) program. Only beef cow-calf producer members of the NCBA were included in the study population. Members of the NCBA not involved with cow-calf production (e.g., cattle feeders, industry professionals or those involved in academia) were excluded from the study population. Involvement in more than 1 sector of the beef industry did not preclude inclusion in the sample population, as long as the producer was also actively involved in cow-calf production. The total sample population included 14,294 NCBA cow-calf producer members.

Sample size calculations

All sample size calculations were performed using statistical software.[a] Previous beef cow-calf producer surveys have achieved a response rate range of 15 to 30%.[11,15–17] Based on an expected response rate of 20%, approximately 2,860 responses would be expected from 14,294 surveyed subjects. Using the representative explanatory variable of operation type (i.e., seedstock vs. non-seedstock), approximately 2,860 questionnaire responses would allow the detection of a difference between 10% prevalence of an outcome among non-seedstock producers and 15% prevalence of the outcome among seedstock producers with 95% confidence if the ratio of non-seedstock producers to seedstock producers was 6:1. This ratio is supported by previous work conducted by the authors.[11] Also, this number of responses would provide 97% confidence with a margin of error of 2% around a probability estimate of 50% for a producer characteristic (e.g., use of any type of CHPR).

Questionnaire development

The survey packet mailed to each NCBA cow-calf producer member included a 1-page letter of introduction, the 2-page questionnaire consisting of 44 multiple choice and fill-in-the-blank questions, and a self-addressed, metered business reply #9 envelope. The letter of introduction to the study included information about the purpose of the study, contact information for investigators, and a statement informing recipients that their responses were anonymous, with no personally identifiable information needed for participation. The questionnaire used in the present study was developed following use of a similar form in a survey of Mississippi cow-calf producers by the investigators.[11,18] The questionnaire was submitted to the Mississippi State University Institutional Review Board (MSU-IRB) for the Protection of Human Subjects for assessment. The study was deemed "Not Human Subjects Research" by the MSU-IRB due to anonymity of respondents, exempting the study from the requirement for IRB approval.

Questions were divided into 4 sections regarding: 1) producer demographic information, 2) current veterinary involvement in the operation, 3) current record-keeping methods, and 4) challenges to record-keeping. Data regarding respondent demographics, current record-keeping methods and challenges to record-keeping are reported here.

Survey implementation

Printing, packaging, addressing and mailing of all survey packets was completed by a third-party printing service.[b] An online version of the survey was created using a commercially available software.[c] The survey software was also used to create a Quick-Response (QR) code and a web address (URL) that were printed in the letter of introduction in order to direct recipients to the electronic questionnaire. Instructions were included in the letter of introduction asking survey packet recipients to complete the questionnaire by only 1 of the following possible methods: 1) complete the paper survey included in the packet and return using the supplied #9 business reply envelope, 2) scan the QR code printed in the letter of introduction and answer the survey with their smartphone, or 3) visit the web link (URL) included in the letter of introduction to answer the survey from a web browser. The survey software restricted users from answering the survey more than once using the same method of response. No further measures were used to prevent duplicate answers because investigators believed the risk of non-response was greater than the risk of recipients willingly completing the questionnaire more than once by different methods of response. Surveys were mailed on July 31, 2020 and both paper and electronic responses were collected for 90 days following initial mailing. Electronic and paper responses were received directly by the investigators. An article was published in the August 2020 edition of the National Cattlemen magazine creating awareness among NCBA members of the project and encouraging participation. To further ensure respondents met the criteria for inclusion in the study, the first question of the survey asked if the respondent was actively involved in cow-calf production. Respondents who answered "No" were excluded from descriptive and inferential analyses. No other reminders, incentives, or repeat mailings were used to enhance participation due to budget constraints.

Outcomes

Outcomes of interest in inferential analysis that are reported here include: 1) whether or not the respondent used any form of CHPR, 2) whether or not the respondent used electronic CHPR, and 3) whether or not understanding currently available record-keeping software was a challenge to CHPR-keeping. Only responses from respondents who indicated they used any form of CHPR were used in the outcome of whether or not understanding currently available record-keeping software was a challenge. Explanatory variables tested for association with these outcomes included: 1) method of response to the survey, 2) type of operation, 3) if the respondent's involvement with the cow-calf operation was their primary source of income, 4) respondent age, 5) respondent gender, 6) respondent herd size, 7) respondent education level, 8) region of the U.S. where the cow-calf operation is located, 9) whether or not any CHPR are maintained for the cow-calf operation, 10) respondent access to a computer for record-keeping purposes, and 11) whether or not internet access was available at the cow-calf operation's office or headquarters.

Statistical analysis

Paper responses were entered into an electronic form designed using open-access epidemiologic tools software.[a] Once all paper responses were entered into the form, the data was exported to spreadsheet software,[d] where it was collated with electronic responses (i.e., QR code and URL) exported from survey software. Descriptive statistics were used to evaluate the data for errors. Because respondents could choose whether or not to answer each question of the survey, response percentages reported for each question were calculated using the total number of responses for each question individually.

Inferential statistics were performed using commercially available statistics software.[e] Using PROC CORR, Spearman Rank correlation coefficients for explanatory variable combinations were assessed. The variables representing access to a computer for CHPR-keeping purposes and internet access availability at the cow-calf operation's office or headquarters had a correlation coefficient of 0.51 (P -value < .0001), making them ineligible to be included together in a multivariable model. No other explanatory variables were observed to be highly correlated. Collinearity among the other 9 explanatory variables was further assessed by using PROC REG to examine variance inflation factors and tolerance values, as well as eigenvalue and condition index collinearity diagnostics.[19] No collinearity was detected by these methods, therefore, all remaining explanatory variables were eligible for use in the multivariable modeling process.

The PROC FREQ procedure was used to examine contingency tables of response count for explanatory variables with more than 2 levels. Explanatory variables with more than 2 levels included respondent age (≤ 34 years, 35-44 years, 45-54 years, 55-64 years, 65-74 years, and ≥ 75 years), herd size (< 10 head, 10-25 head, 26-49 head, 50-99 head, 100-199 head, 200-499 head, 500-1000 head, and > 1000 head), and education level (elementary school, middle school, GED or alternative credential, high-school diploma, some college, Associate's degree, Bachelor's degree, post-graduate degree and professional degree). The PROC LOGISTIC procedure was used to assemble univariable models by logistic regression for each explanatory variable and outcome of interest. The LSMEANS statement and Tukey's HSD test were used to examine differences in the least square means between levels of explanatory variables with more than 2 levels. When few or no responses were present in 1 or more levels, or when Tukey's HSD test revealed no statistical differences among variable levels, levels were collapsed as follows: Respondent age collapsed to ≤ 54 years, 55-64 years, 65-74 years, and ≥ 75 years; herd size collapsed to ≤ 49 head, 50-199 head, and ≥ 200 head; education level collapsed to high-school diploma or less, some college up to completed Bachelor's degree, and post-graduate/professional degree. The "high-school diploma or less" level included respondents who indicated their highest level of education was elementary school, middle school, GED or alternative credential, and high-school diploma. The "some college up to completed Bachelor's degree" level included respondents who indicated their highest level of education was some college, Associate's degree, and Bachelor's degree. The "post-graduate/professional degree" level included respondents who indicated their highest level of education was post-graduate degree (e.g., Master's, PhD, etc.) or professional degree (e.g., DVM, MD, JD, etc.)

Respondents were classified by region of the country based on the state where the cow-calf operation with which they are associated was primarily located. Regions were defined as follows: 1) Southeast: Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, 2) Northeast: Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, Virginia, West Virginia, 3) Midwest: Illinois, Indiana, Iowa, Kentucky, Michigan, Minnesota, Missouri, Ohio, Wisconsin, 4) Southern Plains: Kansas, New Mexico, Oklahoma, Texas, 5) Northern Plains: Nebraska, North Dakota, South Dakota, 6) Mountain: Arizona, Colorado, Idaho, Montana, Nevada, Utah, Wyoming, and 7) West: Alaska, California, Hawaii, Oregon, Washington.

Multivariable models were assembled by manual forward variable selection using PROC LOGISTIC. Variable inclusion or exclusion at each step in the model building process was determined by Wald Type III P-values and Akaike's Information Criterion (AIC) model fit statistics. Because the explanatory variables representing access to a computer for CHPR-keeping purposes and internet access availability at the cow-calf operation's office or headquarters were correlated, each variable was tested separately during the model building process, and model fit statistics used to determine the best model. The LSMEANS statement and Tukey's HSD test was used to evaluate the differences in least square means between differing levels of explanatory variables with more than 2 levels. Within the model of whether or not any form of CHPR were maintained on the cow-calf operation with which the respondent is associated, the following 2-way interactions were tested: operation type and cow-calf operation is primary income source, respondent age and respondent education level, and cow-calf operation is primary income source and respondent education level. Within the model of whether or not electronic CHPR are used on the cow-calf operation with which the respondent is affiliated, the following 2-way interactions were tested: herd size and operation type, access to a computer and respondent education level, and access to a computer and respondent age. Within the model of whether or not respondents said understanding currently available record-keeping software was a challenge to CHPR-keeping on the cow-calf operation with which they are affiliated, the following 2-way interactions were tested: respondent education level and respondent age. Statistical significance for all analyses, including variable inclusion during the model building process, was set a priori at alpha = 0.05.

Results

Of the 14,294 survey packets mailed, a total of 3,741 (26.2%) responses were received. Of these, 3,641 (97.3%) responses met the study inclusion criteria by being actively involved in cow-calf production; 100 (2.7%) respondents indicated they were not actively involved in cow-calf production and were excluded from further analysis. Descriptive results of respondent demographics are reported in Table 1 and Table 2. Descriptive results for method of response are reported elsewhere.[20] Table 3 displays the distribution of responses received from each state. States producing the most responses were: Texas (420), Missouri (243), Kansas (232), Tennessee (200), and Oklahoma (152). No responses were received from Alaska, Connecticut, Massachusetts, New Hampshire, New Jersey, Rhode Island or Vermont. Most respondents identified themselves as the owner of the cow-calf operation (95%), with herd manager being the second most frequently selected category (13.3%) (Table 1). Most respondents indicated that the cow-calf operation with which they were involved was a commercial operation that sold calves at weaning (67.6%), and two-thirds (66.4%) of respondents indicated the cow-calf operation was not their primary source of income (Table 1). Figure 1 displays the percent of respondents who identified the cow-calf operation as their primary source of income by herd size. A total of 74.6% of respondents were 55 years of age or older, and 86.4% of respondents were male (Table 1). Respondents most commonly selected a Bachelor's degree (36.9%) as their highest level of education achieved, and the herd size categories 50-99 head (24%) and 100-199 head (21.7%) were the most frequently selected by respondents (Table 2). The 2 most commonly selected motivations for being in the cattle business were: "I enjoy caring for cattle" (84.2%) and "cattle have always been in my family" (64.6%) (Table 2). The most common written-in responses for motivation for being in the cattle industry were reasons related to lifestyle (9 of 3,631; 0.2%).

Descriptive results for respondent opinions of CHPR topics and types of record-keeping systems used on cow-calf operations, types of data currently being collected on cow-calf operations, and data collection and record-keeping challenges faced by respondents are reported in Tables 4 through 6, respectively. Most respondents (87.4%) said CHPR were maintained on the cow-calf operation with which they were affiliated, and 86.2% of respondents indicated individual animal identification was used for cows and calves. Of 3,133 respondents who described the type of CHPR they used, 1,966 (62.8%) used handwritten, and 1,167 (37.2%) collectively used some form of electronic CHPR (Table 4). Also, of those respondents who kept some form of CHPR, 80.6% kept a record of antibiotic treatments, 81.2% believed CHPR increased the value of cattle when sold, 95.4% believed CHPR can be used to improve the health of cattle, and 96.9% believed CHPR could be used to improve the performance and productivity of cattle (Table 4). When respondents that kept CHPR sold cattle, 41.8% indicated that CHPR were provided to the new owner (Table 4). Table 5 displays descriptive results for the current types of data being collected by respondents who collected some type of CHPR. The most commonly collected types of data by respondents included annual cow inventory (96%), breeding dates (89.3%), calving dates (88.1%), vaccine administration (85.8%), and calf sex at birth (82.6%). Respondents indicated that teat and udder suspension score (17.9%), reproductive tract scores (14.9%), calf vigor score (13.8%), hip height (frame score) (10%), and claw set and foot angle (5.8%) were the least commonly recorded types of data (Table 5). The most commonly identified data collection and record-keeping challenge faced by respondents, regardless of whether they kept any form of CHPR or not, was understanding commercially available CHPR-keeping software (57.2%), while the least frequently identified challenge by respondents was understanding how to use CHPR to improve cattle health and productivity (34.6%) (Table 6). The majority (95.2%) of respondents believed keeping CHPR was worthwhile (Table 6). Descriptive results for veterinary involvement in CHPR-keeping on cow-calf operations and cow-calf producer use of technology in collection and analysis of CHPR are reported elsewhere.[20,21]

Multivariable logistic regression models for the outcomes 1) respondents use of any form of CHPR (i.e., handwritten, electronic or some combination), 2) respondent use of electronic CHPR, and 3) whether or not respondents found understanding how to use currently available CHPR-keeping software a challenge are displayed in Tables 7, 8, and 9, respectively. The explanatory variables respondent age, education level and seedstock production were included in the final multivariable models for all 3 previously listed outcomes. No significant 2-way interactions were identified within each multivariable model.

Factors associated with respondent use of any type of CHPR included: seedstock production (OR = 5.1, 95% C.I.=3.6-7.3; compared to non-seedstock producers), respondent age (≤ 54 years: OR = 2.5, 95% C.I. = 1.8-3.5; 55-64 years: OR = 1.7, 95% C.I. = 1.2-2.3; 65-74 years: OR = 1.3, 95% C.I. = 1.0-1.7; compared to ≥ 75 years), female respondents (OR = 1.7, 95% C.I. = 1.2-2.5; compared to males), the cow-calf operation is the respondent's primary income source (OR = 1.5, 95% C.I. = 1.2-1.9; compared to not being primary income source), and respondent having a post-graduate or professional degree (OR = 1.7, 95% C.I. = 1.2-2.5; compared to a High-school diploma or less) (Table 7).

Factors associated with respondent use of electronic CHPR included: method of response (URL: OR = 3.4, 95% C.I. = 2.6-4.6; QR code: OR = 3.0, 95% C.I. = 2.1-4.3; compared to paper responses), access to a computer (OR = 21.4, 95% C.I. = 6.8-67.6; compared to no computer access), respondent education level (some college up to completed Bachelor's degree: OR = 1.8, 95% C.I. = 1.4-2.4; Post-graduate or professional degree: OR = 2.6, 95% C.I. = 1.9-3.5; compared to High-school diploma or less), herd size (50-199 head: OR = 1.2, 95% C.I. = 1.0-1.4; ≥ 200 head: OR = 1.9, 95% C.I. = 1.5-2.3; compared to ≤ 49 head) seedstock production (OR = 1.8, 95% C.I. = 1.5-2.1; compared to non-seedstock production), and respondent age (≤ 54 years: OR = 1.6, 95% C.I. = 1.2-2.1; 55-64 years: OR = 1.3, 95% C.I. = 1.0-1.7; 65-74 years: OR = 1.0, 95% C.I. = 0.8-1.3; compared to ≥ 75 years) (Table 8).

Factors associated with respondents identifying an understanding of currently available CHPR-keeping software as a challenge to CHPR-keeping included: respondent education level (high-school diploma or less: OR = 2.0, 95% C.I. = 1.5-2.5; some college up to completed Bachelor's degree: OR = 1.3, 95% C.I. = 1.1-1.6; compared to post-graduate or professional degree) respondent age (55-64 years: OR = 1.1, 95% C.I. = 0.9-1.3; 65-74 years: OR = 1.6, 95% C.I. = 1.3-1.9; ≥ 75 years: OR = 1.7, 95% C.I. = 1.3-2.1; compared to ≤ 54 years), and non-seedstock production (OR = 1.4, 95% C.I. = 1.2-1.7; compared to seedstock production) (Table 9).

Table 1: Descriptive results for respondent demographic information.

Question	Number of responses	Percent
Respondents actively involved in cow-calf production*	**3741**	
Yes	3641	97.3
No	100	2.7
Respondent role in the cow-calf operation†	**3628**	
Owner	3449	95
Herd manager	483	13.3
Family member (other than owner or manager)	96	2.6
Employee	25	0.7
Type of cow-calf operation†	**3624**	
Seedstock/purebred	1044	28.8
Commercial – calves sold at weaning	2451	67.6
Commercial – retained ownership after weaning	1227	33.9
Cow-calf operation is respondent's primary source of income	**3613**	
Yes	1213	33.6
No	2400	66.4
Age of respondent	**3629**	
34 years or younger	162	4.5
35-44 years	278	7.7
45-54 years	482	13.3
55-64 years	958	26.4
65-74 years	1143	31.5
75 years or older	606	16.7
Gender of respondent	**3612**	
Male	3120	86.4
Female	492	13.6

* = Data from respondents not actively involved in cow-calf production were excluded from further analyses

† = Respondents could select more than 1 answer; responses total >100%

Discussion

The results of this study describe the CHPR-keeping methods and opinions of cow-calf producer members of the NCBA, and may provide the bovine practitioner insight into the challenges faced by cow-calf producers in the implementation of effective and efficient CHPR-keeping systems. The opinions of NCBA cow-calf members and their methods of CHPR management may not be representative of all U.S. cow-calf producers. However, the subjects of interest in this study were cow-calf producers most likely to be familiar with CHPR. Investigators empirically believe that cow-calf producer members of the NCBA are as familiar or more familiar with CHPR-keeping, when compared to non-NCBA members, due to the emphasis placed on record-keeping by the NCBA and programs such as the NBQA program. Previous work conducted by the authors found that members of a state cattlemen's association commonly used and were familiar with CHPR-keeping topics.[11] Investigators believed that efforts to improve CHPR-keeping would be more successful among producers who are already familiar with CHPR, compared to those who may not be currently collecting or using any form of CHPR. Cow-calf members of the NCBA, therefore, made a convenient sample population whose opinions were of interest to investigators. Attempts to reach other non-NCBA member cow-calf producers were not made because of budget constraints, as well as the belief of investigators that these producers would not be more, and likely less, familiar with CHPR-keeping topics.

The 26% response rate of the current study is not unusual among mail, or mixed-method mail and electronic surveys of cattle producers and exceeded the number necessary based on sample size calculations.[11,15,17,22–25] A few surveys of cattle producers have had higher response rates. A combined survey of beef and dairy producers in the northeastern U.S. done exclusively by paper mailing achieved a response rate of 40%,

Table 2: Descriptive results for respondent demographic information.

Question	Number of responses	Percent
Adult beef cow inventory as of January 1, 2020	**3618**	
Fewer than 10 head	52	1.4
10-25 head	322	8.9
26-49 head	561	15.5
50-99 head	870	24
100-199 head	784	21.7
200-499 head	645	17.8
500-1000 head	254	7
Greater than 1000 head	130	3.6
Respondent's highest level of education	**3625**	
Elementary school	5	0.1
Middle school	10	0.3
GED or alternative credential	25	0.7
High-school diploma	541	15
Some college	654	18
Associate's degree	296	8.2
Bachelor's degree	1337	36.9
Post-graduate degree (Master's, PhD, etc.)	519	14.3
Professional degree (DVM, MD, JD, etc.)	238	6.6
Respondent's motivation for being in the cattle business*	**3631**	
I enjoy caring for cattle	3056	84.2
Cattle have always been in my family	2346	64.6
I have land that wouldn't be used otherwise	1659	45.7
Cattle are significant source of my income	1573	43.3
Cattle are part of my retirement plan	1297	35.7
I have cattle for tax purposes	720	19.8

* = Respondents could select more than 1 answer; responses total >100%; the most common written-in answer was related to lifestyle (9 of 3,631; 0.2%).

however a second mailing was sent to producers who did not respond to the first mailing.[26] This repeat mailing, as well as the inclusion of dairy producers in the study, may explain why the response rate was greater than in the present study. A 2007 paper mailing survey of beef cow-calf producers with 100 head or greater resulted in a response rate of 53.7%, however, repeat mailings of the survey as well as a post-card reminder were used to increase participation.[f] The Dillman Tailored Design Method provides guidelines to tailor the survey to the specific audience, as well as ensure robust response rates for mail, electronic and mixed-method surveys.[24] Components of the present study such as design and content of the cover letter, metered business reply return envelope, web and smartphone survey design, and anonymous methods of response followed the Dillman Tailored Design Method; however, other components such as post-card reminders, repeat mailings to non-responders, or any other follow-up materials sent to non-responders were not used due to budget constraints. Response rates to the present study may have been improved if repeat mailings, incentives, or other strategies to increase response rate had been implemented.[24,27–29] Previous studies have shown characteristics and opinions of non-respondents could be different from respondents.[30,31] Non-response bias was not investigated in the present study because all responses were anonymous; therefore, investigators could not specifically target those producers who did not respond for follow-up.

The regional demographics of survey responses corresponded to the demographics of cow-calf operations in the U.S. According to the United States Department of Agriculture National Agricultural Statistics Service (USDA NASS) 2021 data, the top 5 states for number of beef cows that have calved are Texas, Oklahoma, Missouri, Nebraska, and South Dakota, respectively.[32] The 2017 Census of Agriculture also lists Texas, Missouri, Oklahoma, Kentucky, and Tennessee, respectively, as the top

Table 3: Number of responses by state, with data for number of operations with beef cows by state from the USDA NASS 2017 Census of Agriculture. No responses were received from Alaska, Rhode Island, New Hampshire, Connecticut, Massachusetts, New Jersey or Vermont.

State	Responses	Percent*	Operations†	Operations rank	State	Responses	Percent*	Operations†	Operations rank
TX	420	11.74	134,250	1	**ND**	52	1.45	8,245	31
MO	243	6.79	48,122	2	**SD**	50	1.40	12,613	21
KS	232	6.48	23,682	6	**WY**	47	1.31	4,982	38
TN	200	5.59	32,960	5	**PA**	46	1.29	13,176	19
OK	152	4.25	46,080	3	**MI**	42	1.17	7,445	33
CA	142	3.97	10,254	28	**WV**	42	1.17	10,336	26
MS	114	3.19	14,752	16	**AZ**	40	1.12	5,560	37
KY	105	2.93	33,864	4	**ID**	40	1.12	8,149	32
GA	104	2.91	14,869	15	**WI**	38	1.06	13,954	17
NE	104	2.91	17,707	13	**NM**	33	0.92	8,991	30
IL	101	2.82	13,139	20	**WA**	33	0.92	9,295	29
VA	100	2.79	18,453	11	**UT**	31	0.87	6,508	36
CO	97	2.71	12,407	22	**NY**	24	0.67	7,310	34
IA	96	2.68	19,171	9	**NV**	20	0.56	1,356	41
FL	89	2.49	18,493	10	**HI**	11	0.31	1,047	43
AR	88	2.46	23,036	7	**MD**	6	0.17	2,486	39
AL	85	2.38	20,004	8	**DE**	1	0.03	235	48
NC	84	2.35	16,407	14	**ME**	1	0.03	1,141	42
OH	80	2.24	17,733	12	**AK**	0	0	92	NA
LA	76	2.12	12,051	23	**RI**	0	0	163	NA
IN	69	1.93	11,753	24	**NH**	0	0	602	NA
MN	63	1.76	13,339	18	**CT**	0	0	860	NA
MT	60	1.68	10,290	27	**MA**	0	0	879	NA
OR	59	1.65	11,548	25	**NJ**	0	0	941	NA
SC	58	1.62	6,917	35	**VT**	0	0	1,399	NA

* = Percent based on 3,578 total responses that provided state location for the cow-calf operation

† = Number of operations with beef cows according to the 2017 USDA NASS Census of Agriculture

5 states for numbers of operations with beef cows.[33] Texas, Oklahoma, Missouri, and Tennessee are included in the top 5 states for number of responses to the present study, indicating responses to the present study are well distributed in prominent areas of cow-calf production in the U.S.

The position of the respondent within the cow-calf operation may influence their opinion of CHPR. Investigators recognized that recipients of the survey packet may serve various roles in the cow-calf operation with which they are affiliated. Employees tasked with accomplishing CHPR-keeping by their employers may not share the same opinion of CHPR as the owners of the operation. Investigators speculate that for many cow-calf operations, the owner also serves in an employee or managerial capacity by performing daily tasks, but this may not be the case for all cow-calf operations. Because most respondents identified themselves as being in a position of ownership on their affiliated cow-calf operation (Table 1), the results presented in this study may not accurately represent the opinions of workers or employees who are not in a position of ownership and did not have the opportunity to answer the questionnaire, but are tasked with the daily responsibility of collecting and recording CHPR.

It is not surprising that most respondents to the present study were affiliated with commercial cow-calf operations (Table 1). A 2021 study of cow-calf producers in Mississippi similarly found commercial cow-calf producers to be the majority of respondents.[11] A survey that utilized the membership of the Red Angus Association of America and the Idaho Cattle Association, as well as the Red Angus Association of America's bull buyer list found the largest portion of respondents were

Table 4: Descriptive results for respondent opinions and methods of CHPR-keeping.

Question	Number of responses	Percent
Current use of individual animal identification*	**3616**	
Yes – cows and calves	3118	86.2
Yes – cows only	349	9.7
No	149	4.1
Are CHPR maintained on the cow-calf operation? *	**3624**	
Yes	3169	87.4
No	455	12.6
Primary method of CHPR-keeping†	**3133**	
Hand-written records	1966	62.8
Commercially available cattle record-keeping software	474	15.1
Microsoft Excel or similar spreadsheet software	622	19.9
Smart-phone application	71	2.3
Is a record of antibiotic treatments maintained?†	**3130**	
Yes	2524	80.6
No	606	19.4
Do you believe CHPR increases value of cattle when sold?†	**3086**	
Yes	2507	81.2
No	579	18.8
Do you believe the overall health of cattle can be improved by maintaining CHPR?†	**3099**	
Yes	2956	95.4
No	143	4.6
Do you believe that maintaining CHPR facilitates improvements in cattle productivity and performance?†	**3097**	
Yes	3000	96.9
No	97	3.1
When cattle are sold, are their health and production records given to the new owner?†	**3082**	
Yes	1288	41.8
No	1595	51.8
I don't know	199	6.5

* = Data from all respondents actively involved in cow-calf production included in total responses

† = Data from only respondents who indicated CHPR were maintained on the cow-calf operation are included in total responses

affiliated with commercial cow-calf operations.[34] The 2017-2018 USDA NAHMS Beef Study found 77.3% of cattle operations for which survey responses were received were commercial, 16.9% were commercial and seedstock, and 5.9% were exclusively seedstock.[35]

Many cow-calf operations are diversified agricultural businesses, with a portion of the total income derived from cow-calf production. In other instances, small cow-calf producers have off-farm employment that serves as their primary source of income, and the cow-calf operation serves as supplemental income. A 2021 study of cow-calf producers in Mississippi found 12% of respondents identified the cow-calf operation as their primary (> 50%) source of income.[11] The 2012 Census of Agriculture found 45% of cattle producers identified the farming operation as their primary occupation, with 87% of cattle producers deriving less than 50% of their income from the farming operation.[36] More recently, the 2017-2018 USDA NAHMS Beef Study found 81.3% of cow-calf operations act as a supplemental source of income for producers.[35] The results of the present study indicate approximately two-thirds of respondents having a primary income source outside of the

Table 5: Descriptive results of the types of data currently being collected on the cow-calf operation with which the respondent is associated.

Data collected	Number of responses	Percent
	3160	
Annual cow inventory	3035	96.0
Breeding dates (or bull turn-out date)	2821	89.3
Cattle purchase records	2331	73.8
Cattle location on farm	1829	57.9
Disposal code for cows or calves	1637	51.8
Pasture herbicide/pesticide use	1361	43.1
Hip height (frame score)	317	10.0
Claw set and foot angle	184	5.8
	3159	
Vaccine administration	2709	85.8
Dewormer administration	2527	80.0
Pregnancy status	2397	75.9
Mature cow age	2024	64.1
Weaning weights	1898	60.1
Mature cow body condition score (BCS)	764	24.2
Mature cow weights	759	24.0
Reproductive tract scores	470	14.9
	3163	
Calving date	2786	88.1
Calf sex at birth	2612	82.6
Identification linking calf to dam	2315	73.2
Calving difficulty or ease scores	1648	52.1
Birth weights	1292	40.8
Dam disposition score	967	30.6
Teat and udder suspension score	566	17.9
Calf vigor score	438	13.8

cow-calf operation. As can be seen from Figure 1, the cow-calf operation is the primary source of income more often for respondents with > 200 head, compared to smaller herd sizes. Larger herd sizes often require more financial commitment and time invested in management, meaning producers may have less opportunity for work outside the cow-calf operation.

Age of producer in the present study is consistent with other estimates of U.S. cow-calf producer age. The 2012 U.S. Census of Agriculture found that of producers whose primary occupation was the cattle operation, approximately 72% were 55 years of age or older. For producers, whose primary occupation was something other than the beef cow-calf operation, approximately 51% were 55 years of age or older.[37] Results from the present study indicate the percentage of beef cow-calf producers who are 55 years or older has changed minimally in the previous decade. Similar responses regarding age of producer have been observed when state level cattle producer organizations have been surveyed.[11] Investigators speculate that there may be multiple factors influencing age of beef cow-calf producers in the U.S., including high start-up cost prohibiting new, younger producers from entering the industry, and decreased interest in cow-calf production among younger generations.

The percent of respondents to the present study with less than 50 head is smaller than previous studies. The 2017 Census of Agriculture found 77% of beef cow-calf operations had less

Table 6: Descriptive results of data collection and record-keeping challenges faced by respondents. Data from respondents who indicated CHPR were and were not currently being maintained on the cow-calf operation with which they are involved are included in the total number of responses.

Challenge	Number of responses	Percent
Finding time to collect and record CHPR	**3564**	
Yes	1984	55.7
No	1580	44.3
Finding human labor to collect and record CHPR	**3566**	
Yes	1735	48.7
No	1831	51.3
Understanding commercially available cattle health and production record-keeping software	**3435**	
Yes	1966	57.2
No	1469	42.8
Understanding computer technology needed for electronic CHPR	**3560**	
Yes	1541	43.3
No	2019	56.7
Expense associated with tools (i.e., computer, electronic scales, etc.) needed to collect electronic CHPR	**3536**	
Yes	1602	45.3
No	1934	54.7
Understanding how to use CHPR to improve cattle health and productivity	**3529**	
Yes	1220	34.6
No	2309	65.4
Do you believe keeping CHPR is worthwhile?	**3533**	
Yes	3362	95.2
No	171	4.8

than 50 beef cows and heifers that had calved. A 2021 survey of cow-calf producers in Mississippi found 51% of respondents had less than 50 head.[11] Investigators speculate that NCBA members may, on average, have larger herd sizes than non-NCBA members, thus explaining the overall larger herd sizes observed in the present study. This may be because larger herd sizes demand a larger time and financial investment, and subsequently contribute a large portion of the producer's income, meaning producers with large herd sizes are willing to participate in producer advocacy groups such as the NCBA because they perceive membership in these organizations and the work done by the organizations (e.g., political representation of producer interests, etc.) as being good for their own financial success.

The percentage of respondents to the present study who were female is slightly larger than previously reported industry statistics which indicated 9% of beef operations in the U.S. being operated by women.[38] This difference could be attributed to respondents of the present study being the person who was most likely to open or complete the survey, but not be the principle operator of the operation. Also, previously reported industry statistics include all cattle operations in the U.S., not just beef cow-calf operations as in the present study.

Interestingly, the top motivation for being in the cattle business was enjoyment of caring for cattle, rather than any financial motivation, followed closely by cattle having always been in the family of the respondent. The investigators speculate that the actions of many producers are not primarily motivated by financial reasoning; when making decisions that involve their cattle operation, respondents appear to be more motivated by pleasure and lifestyle. This information can be of particular use when designing and implementing producer education and extension programs. Although respondents were given the opportunity to write-in their motivation for being in the cattle industry, investigators found that very few of the written-in responses differed from the available answer choices. Most written-in comments were further explanations of, for example, why the producer enjoyed caring for cattle or why cattle have always been in their family. Therefore, no additional motivations that were not previously captured in the available answer choices were identified by the investigators as being commonly written-in.

Maintaining CHPR-keeping systems are difficult if animals

Table 7: Multivariable logistic regression model for whether or not any form of CHPR (i.e., handwritten, electronic, or some combination) were maintained on the cow-calf operation with which the respondent is associated. Outcome modeled as the probability that respondents used any form of CHPR.

Explanatory variable	Level	Responses*	Parameter	Standard error	Odds ratio	95% C.I.		*P*-value
Intercept			0.92	0.16				<.0001
Seedstock production								
	Yes	1032	1.64	0.18	5.1	3.6	7.3	<.0001
	No	2530	Ref.	Ref.	1.0	Ref.		
Respondent age								
	≤ 54 yrs[a]	909	0.91	0.17	2.5	1.8	3.5	<.0001
	55-64 yrs[ab]	950	0.52	0.15	1.7	1.2	2.3	
	65-74 yrs[bc]	1116	0.25	0.14	1.3	1.0	1.7	
	≥ 75 yrs[c]	587	Ref.	Ref.	1.0	Ref.		
Respondent gender								
	Female	484	0.53	0.19	1.7	1.2	2.5	0.0044
	Male	3078	Ref.	Ref.	1.0	Ref.		
Cow-calf operation is respondent's primary income source								
	Yes	1189	0.41	0.12	1.5	1.2	1.9	0.0005
	No	2373	Ref.	Ref.	1.0	Ref.		
Respondent education level								
Post-grad. or Prof. degree [a]		742	0.55	0.18	1.7	1.2	2.5	0.0024
Some college up to completed Bachelor's degree[b]		2248	0.07	0.14	1.1	0.8	1.4	
High-school diploma or less[b]		572	Ref.	Ref.	1.0	Ref.		

* = 3,562 total responses were used in this model

[a,b,c] = levels with a common letter were not statistically different by Tukey's HSD test for multiple comparisons among variable levels

cannot be individually identified. The 2017-2018 USDA NAHMS Beef Study found 80.4% and 65.8% of cattle operations, regardless of size, used some form of individual animal identification on at least some cows and some calves, respectively. A larger percentage (86.2%) of respondents to the present study used individual animal identification on cows and calves compared to the results of the 2017-2018 USDA NAHMS Beef Study; this may be a result of the target population being NCBA members. It is not surprising that individual animal identification and record-keeping was common among NCBA members (Table 4), as the NCBA advocates for these practices among its members through the NBQA program.[39] Investigators speculate that national identification programs, such as the National Animal Identification System (NAIS) or the current Animal Disease Traceability (ADT) system, may also have served to introduce some producers to electronic individual animal identification and records.[12]

Many respondents believed CHPR increase the value of cattle when they are sold and can be used to improve the overall health, performance and productivity of cattle, but relatively few indicated that CHPR were provided when cattle were sold (Table 4). This may indicate a belief among respondents that CHPR are beneficial to their operation, but have no utility across segments of the industry; this producer mindset may explain why inter-sector transfer of data in the beef industry is rare.

As previously described, the explanatory variables age of producer and herd size were collapsed from their initial levels during inferential analysis. As a result, all producers less than or equal to 54 years of age were within one age level. This level likely represents a group of respondents with very diverse experience, knowledge, and resource availability. In the present study, however, no differences in the CHPR-keeping methods and opinions among producers less than or equal to 54 years of age were seen. The lack of a difference seen between respondents less than or equal to 54 years of age may be due to these ages being underpowered (i.e., fewer responses) compared to other age levels. Investigators speculate that if the sample population differed, or if more responses had been obtained from younger producers, differences among CHPR-keeping outcomes may have been seen among respondents less than or equal to 54 years of age. Similarly, diversity in operational goals, resources, and management may exist in herd sizes of less than or equal to 49 head. However, the data presented here indicates that respondents with herds of, for

Table 8: Multivariable logistic regression model results for whether or not electronic CHPR were used on the cow-calf operation with which the respondent was associated. Responses eligible to be included in this model were from producers who kept any form of CHPR (i.e., handwritten or electronic). Outcome modeled as the probability that respondents used electronic CHPR.

Explanatory variable	Level	Responses*	Parameter	Standard error	Odds ratio	95% C.I.		*P*-value
Intercept			-4.9	0.6				<0.0001
Method of response								
	URL[a]	234	1.23	0.15	3.4	2.6	4.6	<0.0001
	QR code[a]	146	1.09	0.19	3.0	2.1	4.3	
	Paper[b]	2720	Ref.	Ref.	1.0	Ref.		
Access to a computer								
	Yes	2929	3.07	0.60	21.4	6.8	67.6	<0.0001
	No	171	Ref.	Ref.	1.0	Ref.		
Respondent education level								
	Post-grad. or Prof. degree[a]	673	0.96	0.14	2.6	1.9	3.5	<0.0001
	Some college up to completed Bachelor's degree[b]	1945	0.60	0.13	1.8	1.4	2.4	
	High-school diploma or less[c]	482	Ref.	Ref.	1.0	Ref.		
Respondent herd size								
	≥200 head[a]	897	0.64	0.11	1.9	1.5	2.3	<0.0001
	50-199 head[b]	1404	0.15	0.10	1.2	1.0	1.4	
	≤49 head[b]	799	Ref.	Ref.	1.0	Ref.		
Seedstock production								
	Yes	993	0.57	0.08	1.8	1.5	2.1	<0.0001
	No	2107	Ref.	Ref.	1.0	Ref.		
Respondent age								
	≤ 54 years[a]	840	0.48	0.13	1.6	1.2	2.1	<0.0001
	55-64 years [ab]	829	0.27	0.13	1.3	1.0	1.7	
	65-74 years [bc]	952	0.03	0.13	1.0	0.8	1.3	
	≥ 75 years [bc]	479	Ref.	Ref.	1.0	Ref.		

* = a total of 3,100 responses were used in this model

[a,b,c] = levels with a common letter were not statistically different by Tukey's HSD test for multiple comparisons among variable levels

example, 5 cows or 40 cows, do not differ regarding in their use of electronic CHPR (Table 8).

The model results in Table 7 for producers who kept any type of CHPR were also not surprising. Seedstock producers are often required to collect many pieces of data in order to participate in animal registries of breed associations. Furthermore, many breed associations require electronic submission (i.e., internet) of CHPR, making it expected that seedstock producers would also be familiar with electronic CHPR (Table 8). The authors speculate that the association observed between female producers and keeping any form of CHPR may be attributed to these women being the persons on operations who use CHPR who are most likely to open and respond to the mailed survey (Table 7). Similarly, the association seen between keeping any type of CHPR (i.e., handwritten, electronic, or some combination) and producers who derive their sole source of income from the cow-calf operation may be explained by those producers desiring to pay close attention to details of cattle health and production that could impact them financially (Table 7). Electronic cattle health and production records were used by 37.2% of respondents compared to 26% of respondents to a survey of cow-calf producers in Mississippi.[11] Investigators speculate that producers under the age of 55 may not be as financially stable as older producers, and may have had more exposure or be more accustomed to methods of record-keeping compared to older producers, explaining the association between age of producer and whether or not they keep any CHPR in Table 7. Similar to the present study, producer education level was determined to be associated with whether or not the producer uses electronic CHPR on their

Table 9: Multivariable logistic regression model results for whether or not respondents said understanding currently available record-keeping software was a challenge to CHPR-keeping on the cow-calf operation with which they are affiliated. Only responses from respondents who indicated they were currently using CHPR are included in this model. Outcome modeled as the probability that respondents found currently available software challenging to understand.

Explanatory variable	Level	Responses*	Parameter	Standard error	Odds ratio	95% C.I.		*P*-value
Intercept			-0.50	0.11				<0.0001
Respondent education level								
	High-school diploma or less[a]	454	0.70	0.13	2.0	1.5	2.5	<0.0001
	Some college up to completed Bachelor's degree[b]	1863	0.30	0.09	1.3	1.1	1.6	
	Post-grad. or Prof. degree[c]	649	Ref.	Ref.	1.0	Ref.		
Respondent age								
	≥ 75 years[a]	444	0.50	0.12	1.7	1.3	2.1	<0.0001
	65-74 years[a]	902	0.45	0.10	1.6	1.3	1.9	
	55-64 years[b]	805	0.10	0.10	1.1	0.9	1.3	
	≤ 54 years[b]	815	Ref.	Ref.	1.0	Ref.		
Seedstock production								
	No	2021	0.36	0.08	1.4	1.2	1.7	<0.0001
	Yes	945	Ref.	Ref.	1.0	Ref.		

* = a total of 2,966 responses were used in this model

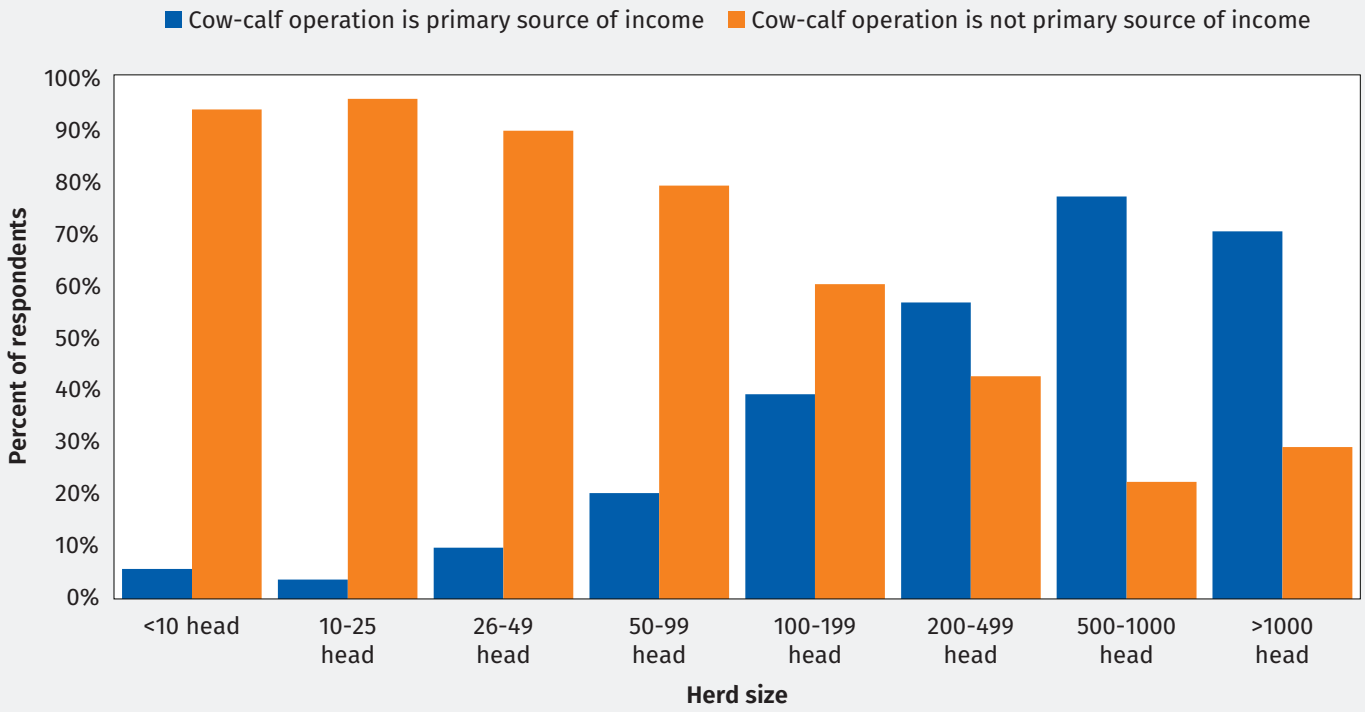
[a,b,c] = levels with a common letter were not statistically different by Tukey's HSD test for multiple comparisons among variable levels

operation in a study of cow-calf producers in Mississippi.[11] The association seen between level of education and the outcomes in Tables 7 and 8 may be explained by considering that producers with at least a Bachelor's degree have likely worked with some type of data in their education, helping them understand the benefits of CHPR, and especially those collected in electronic formats. When considering those producers who had greater odds of using electronic CHPR, responding electronically to the questionnaire, having access to a computer likely describes a producer who is comfortable and familiar with technology in their daily lives. This familiarity with technology likely explains their willingness to use electronic CHPR (Table 8). The association between increasing herd size and odds of using electronic CHPR may be explained by handwritten records being cumbersome and extensive for large herds; therefore, producers with large herds likely find electronic records easier to use and manage, compared to handwritten records.

Many of the most infrequently collected types of data by respondents to the present study have tremendous value in monitoring and improving cattle health and production on cow-calf operations (Table 5). For example, mature cow body condition score (BCS), mature cow weights, and reproductive tract scores can all aid in evaluating reproductive efficiency in a cow-calf herd. According to the 2017-2018 USDA NAHMS Beef Study, 13.6% of all cattle operations utilized BCS as a means to improve reproductive efficiency.[35] Body condition scoring of cattle was more prevalent (24.2%) among respondents to the present study, however BCS was still relatively infrequently collected compared to other cattle health and production data. Calf vigor score and teat and udder suspension can be used to evaluate neonatal calf morbidity and mortality, and preweaning performance. Hip height and claw set and foot angle, although useful for any cow-calf herd, are likely most often collected by seedstock producers as component data for Expected Progeny Differences (EPD) calculations. It is interesting that claw set and foot angle were the least commonly recorded type of data; these data are used to quantify foot and leg conformation, an important component to the beef cow longevity. Investigators speculate that although many respondents do not objectively record claw set and foot angle, they likely attempt to evaluate these traits subjectively by evaluating phenotype when making breeding decisions.

Responses to the present study indicate a need for a simple, efficient, and convenient electronic method of capturing CHPR. Although many CHPR-keeping software options are available today, results of the present study indicate these options are challenging for respondents to use. Future efforts to develop novel CHPR-keeping systems should focus on delivering a simple, effective, and easy-to-use product that is not time consuming, or perceived by producers as a challenge to operate. Investigators speculate that producers who are not currently collecting cattle health and production data may be difficult to convince to adopt new record-keeping technology. Efforts to develop new CHPR software options, as well as to educate producers who currently collect CHPR on the use of existing software options, should consider producer age, education level, and type of operation (Table 9). Producers with a Bachelor's degree or greater are likely more familiar with data collection through their education experiences, making them less likely

Figure 1: Distribution of responses by herd size and whether or not the cow-calf operation is the respondent's primary source of income. Percentages are based on the total number of responses for each herd size category.



to find using current CHPR software a challenge. Similarly, older producers may not be as familiar with technologies needed to operate electronic CHPR software. Producers not involved in seedstock production do not have many of the specific needs of CHPR software (e.g., submitting electronic animal data for registration purposes or generating EPDs) that seedstock producers do; therefore, non-seedstock producers likely find CHPR software a challenge to use simply because they are not as accustomed to using such programs.

Conflict of interest

The sampling frame for this study was provided by the National Cattlemen's Beef Association (NCBA). The authors declare no conflict of interest.

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Endnotes

[a]Epi Info 7.2.2.6, CDC, 2018.
[b]OneTouchPoint, Denver, CO
[c]Qualtrics Online, Mississippi State University, Starkville, MS
[d]Microsoft Excel, Microsoft Corporation, Redmond, WA
[e]SAS for Windows v9.4, SAS Institute, Inc., Cary, NC
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