

Economic Contribution of the Veterinary Medicine Industry in Minnesota

**A REPORT OF THE ECONOMIC IMPACT ANALYSIS PROGRAM
UNIVERSITY OF MINNESOTA EXTENSION AND THE DEPARTMENT OF APPLIED ECONOMICS**

Brigid Tuck, Jin-Young Moon, Brian Buhr, and Bruce Schwartau



Economic Contribution of the Veterinary Medicine Industry in Minnesota

**A REPORT OF THE ECONOMIC IMPACT ANALYSIS PROGRAM
UNIVERSITY OF MINNESOTA EXTENSION AND THE DEPARTMENT OF APPLIED ECONOMICS**

March 2012

Brigid Tuck, Analyst/Writer, Extension
Jin-Young Moon, Graduate Student, Applied Economics
Brian Buhr, Professor, Applied Economics
Bruce Schwartau, Extension Educator, Extension

Partners/Sponsors:

University of Minnesota College of Veterinary Medicine
Minnesota Veterinary Medical Association

© 2012 Regents of the University of Minnesota. All rights reserved. University of Minnesota Extension is an equal opportunity educator and employer. In accordance with the Americans with Disabilities Act, this material is available in alternative formats upon request. Direct requests to the Extension Store at 800-876-8636. ♻️ Printed on recycled and recyclable paper with at least 10 percent postconsumer waste material.

Table of Contents

1. SUMMARY	3
2. VETERINARY MEDICINE IN MINNESOTA	4
History	4
Private Practice	4
Animal Agriculture	5
The Medical Device Industry	6
Government	6
Education	7
This Study	7
3. ECONOMIC CONTRIBUTION	8
Direct Effects	8
-Private Veterinary Practices and Clinics	8
-Private Industry Veterinarians	9
-Government Veterinarians	9
-Academia	10
Induced and Indirect Effects	10
Total Effects	10
-Private Veterinary Practices and Clinics	11
-Private Industry Veterinarians	11
-Government Veterinarians	12
-Academia	13
4. NOTES ON THE ANALYSIS	14
5. CONCLUSIONS	15
5. APPENDIX 1: METHODOLOGY	16

“The Economic Contribution of the Veterinary Medicine Industry in Minnesota”: Summary

The following is a summary of the results of a recent University of Minnesota Extension and Department of Applied Economics study titled “The Economic Contribution of the Veterinary Medicine Industry Minnesota.”

- The *total economic contribution* of the veterinary medicine industry in Minnesota is an estimated \$1.5 billion. This includes an estimated \$680 million in wages and salaries paid to Minnesota workers. As a result of the industry’s presence in Minnesota, 14,500 individuals are employed.
- The largest share of economic contribution for the veterinary medicine industry is derived from *private veterinary practices and clinics*. Private clinics and practices employed 7,700 workers in 2010, including an estimated 1,800 veterinarians. As a result of this employment, an estimated total of \$1.2 billion in economic activity was generated, including an estimated \$550 million in labor income and an additional 4,600 jobs.
- *Private industry veterinarians*, like those employed by medical device manufacturers, also contribute to the veterinary medicine industry. In 2010, there were an estimated 80 private industry veterinarians in the state. As a result of the spending of their incomes, an estimated total of \$37 million in economic activity was generated in Minnesota.
- *Government veterinarians* are employed to guard animal and human health. In 2010, there were an estimated 97 veterinarians working for both the federal and state governments in Minnesota. As a result of the spending of their incomes, an estimated total of \$24 million in economic activity was generated in Minnesota.
- *Training and educating veterinarians and veterinary technicians* also contributes to the economy. The College of Veterinary Medicine at the University of Minnesota, trains and educates veterinarians in Minnesota. Thirteen private and public institutions of higher education train veterinary technicians. Together, the College and the other institutions employed 930 individuals in 2010. As a result of spending by the institutions and their employees, an estimated \$230 million in output was contributed to the state economy.
- There are 2,001 active, licensed veterinarians in Minnesota with Minnesota addresses.
- There are 2,385 certified veterinary technicians in Minnesota.



UNIVERSITY OF MINNESOTA | EXTENSION

VETERINARY MEDICINE IN MINNESOTA

History

The practice of veterinary medicine has a long history in Minnesota, dating back to the early years of statehood. According to the Minnesota Veterinary Historical Museum, the first veterinary school was founded in 1881 in Minneapolis. In 1893, the state of Minnesota passed a Practice Act, granting the Governor authority to appoint a Board of Veterinary Medicine. This Board has since licensed veterinarians. Graduates of the veterinary school established the Minnesota Veterinary Medical Association in 1897 with the goal of advancing the field and providing opportunities for professional development.

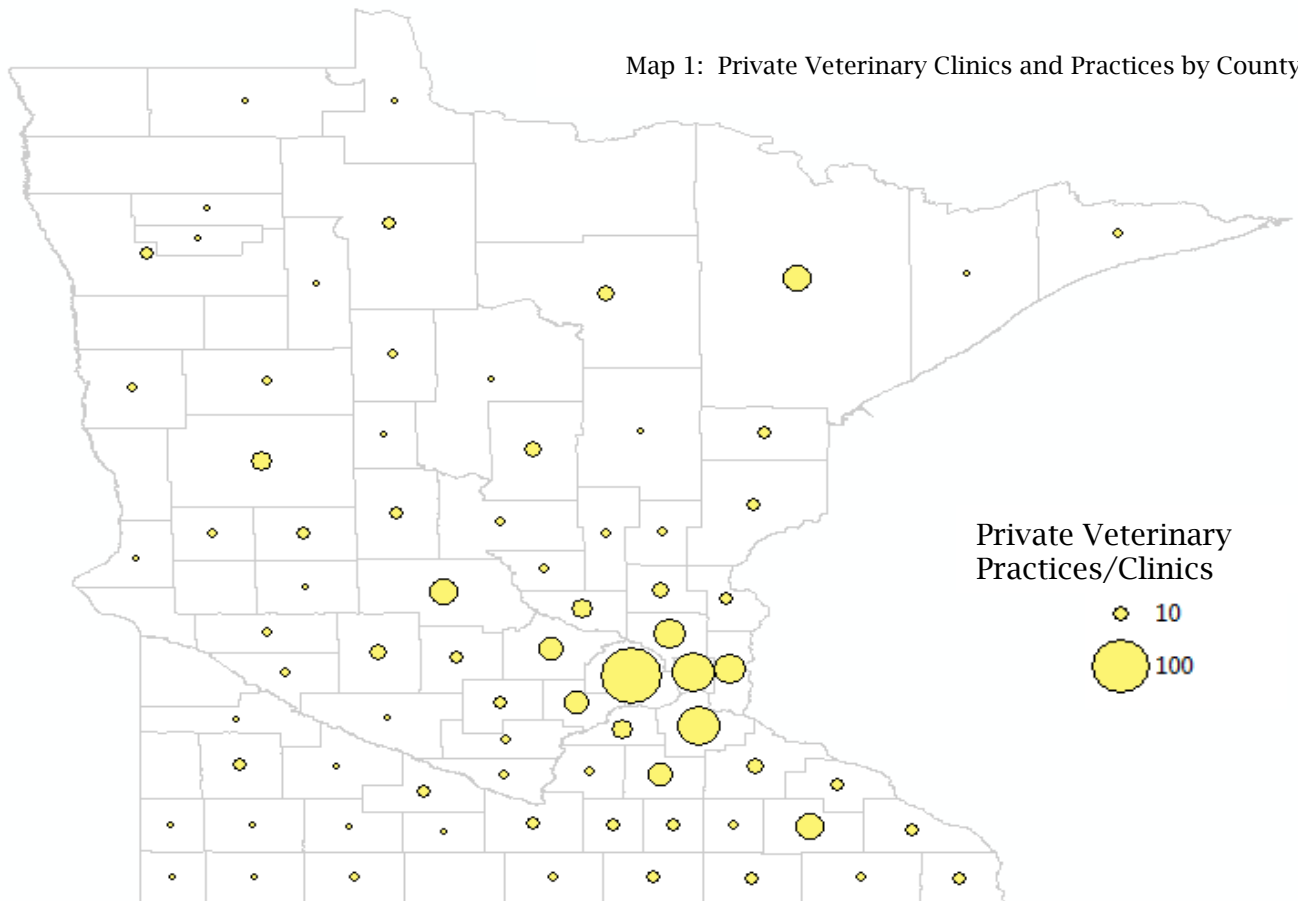
The industry of veterinary medicine has evolved and expanded since the late 1800's. While many veterinarians are still practicing in the field of animal agriculture, veterinarians in Minnesota are now involved in a diverse set of

activities. There are veterinarians practicing in small and large animal private practices and clinics. The field of caring for pets has grown exponentially. There are veterinarians working to improve human health, as employees of medical device corporations. There are veterinarians working within the government to protect both animal and human health. Finally, veterinarians continue to support the education of future veterinarians and veterinary technicians in the state

Private Practice

The majority of Minnesota's veterinarians are employed in private practices and clinics. Given the growing popularity of household pets, it is not surprising the preponderance of Minnesota's clinics and practices (70 percent) exist to serve small animals.

Although private veterinary practices and clinics are concentrated in and around the Twin Cities metropolitan area, veterinarians operate



Source: InfoUSA

clinics and practices in every corner of the state. Map 1 illustrates the location of private clinics and practices by county. The larger dots indicate a higher number of businesses in that county.

A higher concentration of private practices and clinics is clearly related to population. As mentioned, a larger cluster of practices and clinics exist in the Twin Cities metropolitan area. There are also clusters noticeable around out-state regional centers, such as Rochester, Duluth, and St. Cloud.

Further, the private practices and clinics map corresponds with some of Minnesota's highest animal agriculture zones. Hog production is a large industry in southern Minnesota. The map also shows high concentrations of private practices and clinics in the dairy producing areas of central Minnesota.

Finally, the map reveals one more truth of the veterinary medicine industry in Minnesota. Veterinarians are part of all communities, regardless of size or location.

Animal Agriculture

Animal agriculture includes raising livestock to provide meat, milk, fiber and other products to consumers. Minnesota has a large and diverse animal agriculture sector that includes beef, chicken, pork, turkey, egg, and dairy production. Combined, animal agriculture accounts for nearly \$8 billion in direct economic value added. This adds over \$2 billion per year to the state's crop industry and another \$3.4 billion in processing livestock products into consumer meat, dairy, and egg products.

Minnesota ranks in the top 10 nationally in pork (3), turkey (1), milk (6), and beef (10) production. Given this scale, animal agriculture contributes over 34.5 thousand jobs to the state's economy, including veterinarians.

Veterinarians play many different and important roles in animal agriculture. Maintaining the health of livestock improves

their growth rates and welfare and ensures improved productivity that helps keep animal protein an affordable part of consumers' food budget. In this regard, veterinarians are central in designing health management protocols in production systems and ensuring the safe and effective use of treatments that maintain animal health while assuring product safety.

Veterinarians also are engaged in monitoring food borne pathogens, such as bacteria, to assure the meat products are safe and wholesome for consumers. This includes monitoring production and processing practices, as well as conducting tests and audits of meat supply chains. These are considered public health roles of veterinarians. Another public health role related to animal agriculture is the overall monitoring of infectious diseases in livestock. This helps to rapidly identify contagious diseases that infect animals, determine the source of the disease and prevent further spread, reducing the potential for epidemics. For example, veterinarians played a crucial role in managing the outbreak of bovine tuberculosis in Minnesota, identifying transmission pathways between domestic livestock and wild animal populations, such as deer or badgers, and acting to implement control and eradication strategies that resulted in the successful containment of the disease, thereby reducing the economic impacts of the disease in Minnesota. Similarly, veterinarians are on the front lines of monitoring, managing, and intervening in zoonotic diseases (diseases that infect both humans and animals) such as avian influenza (influenza H5N1), bovine tuberculosis or brucellosis.

The economic impacts of veterinary contributions to animal agriculture are difficult to estimate, partly because they represent a service contribution component much as the farmers themselves or people working in processing, but partly because the value of their efforts depends on a 'non-event'. That is, we know that improved veterinary care improves health and reduces costs of production – but we can't observe the economic costs of the diseases they've prevented or how much they've

been reduced. Further, the containment of something like avian influenza H5N1 reduces potential catastrophic human illness and mortality – what is the value of that?

The Medical Device and Pharmaceutical Industry

Veterinarians provide critical services to the medical device industry in Minnesota. Medical devices are items that treat diseases by affecting the structure of the body and not through chemical reactions. Examples include heart valves, pacemakers, or vascular stents. Veterinarians work in both the development and testing of medical devices often using animals as models for their development and testing. Animals are also used directly for medical treatment of humans; for example, heart valves harvested from pigs can be used to replace human heart valves. The medical device industry is one of Minnesota's largest manufacturing industries. In 2011, the industry employed approximately 29,000 people and paid \$588 million in wages. Examples include Medtronic, Boston Scientific and St. Jude Medical.

Veterinarians also play an important role in the pharmaceutical industry. The pharmaceutical industry uses applied chemistry, biochemistry, and genomics to develop products that enhance both human and animal health. Vaccines or biologics are used to protect meat animals and pets from viruses and parasites and are increasingly being used to prevent cancer. Antibiotics are used to improve animal health caused by bacterial agents. Antifungals, anthelmintics and parasiticides also improve animal health and wellbeing by preventing or eliminating fungal infections, worms, or other parasites such as ticks that carry other diseases such as Lyme's Disease. Veterinarians work in research and development to invent new pharmacological products, and also work in clinical trials proving their effectiveness for animal or human diseases.

Veterinarians clearly play an important role in helping this industry to thrive and grow in Minnesota.

Government

Veterinarians employed by the state and federal government are charged with ensuring human and animal health and safety in the state. Federal veterinarians work for several different agencies. The Animal and Plant Health Inspection Service, has the role of testing and monitoring for diseases in livestock to prevent their spread. In addition, APHIS monitors outbreaks and helps implement programs to control or eradicate emergent diseases (<http://www.aphis.usda.gov>). The Food Safety and Inspection Service (FSIS), whose mission is to ensure the safety of the nation's commercial meat, poultry, and egg production, also employs veterinarians. Approximately 1,100 veterinary medical officers nationally work for FSIS. FSIS veterinarians inspect meat-processing plants and monitor slaughter processes to ensure sanitary standards are met. In addition, they assure humane slaughter practices and may work as auditors or epidemiologists to investigate and eliminate food borne illness outbreaks (<http://www.fsis.usda.gov>). The Centers for Disease Control and Prevention employs a small number of veterinarians working in areas of bioterrorism, environmental health, food safety and viral or bacterial diseases. They often focus on zoonotic diseases, those that affect humans and animals, such as West Nile virus, avian influenza, tuberculosis, or Lyme's Disease (<http://www.cdc.gov>). All play a vital role in assuring public health as the same bacteria and viruses that affect animals frequently affect humans as well.

Veterinarians employed by the state operate in several branches of the government. There are veterinarians working for the Board of Animal Health, for the Minnesota Department of Health, for the Departments of Agriculture and Natural Resources, and for the Minnesota Zoo. Finally,

there is the Minnesota Board of Veterinary Medicine.

Education

Veterinarians are skilled professionals with extensive education and training. In Minnesota, veterinarians can receive education at the University of Minnesota's College of Veterinary Medicine. The College prepares future leaders in companion animal, food animal, and public health practice, as well as research and education. The College is one of the largest teaching hospitals in the country, as is home to world renowned faculty in zoonotic diseases, comparative medicine, and population systems.

Beyond training the next generation of veterinarians, the College participates in research, outreach, and service. The Veterinary Medical Center is an advanced, full-service referral care center for large and small animals in Minnesota. The University of Minnesota Veterinary Diagnostic Laboratory (VDL) provides rapid diagnosis of animal diseases, identifies emerging diseases, develops new diagnostic methods, and trains diagnosticians and veterinarians. VDL is the official laboratory of the Minnesota Board of Animal Health.

The College's Veterinary Medicine and Comparative and Molecular Biosciences graduate programs prepare students for careers in biomedical sciences and higher education. Students can pursue master's or Ph.D. degrees in diverse disciplines including genomics, molecular biology, comparative medicine, pathology, internal medicine, surgery, and theriogenology.

Veterinary technicians also receive advanced training. Veterinary technician training programs are offered at thirteen private and public higher education institutions located throughout Minnesota.

This Study

Given the diverse nature of the industry, the College of Veterinary Medicine and the

Minnesota Veterinary Medical Association posed the question "What is the economic contribution of the veterinary medicine industry in Minnesota?" To answer this question, the College and the Association partnered with University of Minnesota Extension's Economic Impact Analysis program and with the Department of Applied Economics. This report is the summation of the analysis conducted to answer the question.

ECONOMIC CONTRIBUTION

Total economic contribution is equal to the summation of direct, indirect, and induced effects. The direct effect is the economic activity of the veterinary medicine industry. The direct effect triggers additional economic activity to occur, therefore setting off a ripple in the local economy. These ripples fall into two categories, indirect effects (created by business-to-business transactions) and induced effects (created by consumer-to-business transactions). In an economic contribution analysis, researchers quantify the direct effects. An input-output model then measures the indirect and induced effects. In this study, researchers determined the direct effect using a combination of primary and secondary data collection. The input-output model used was IMPLAN (MIG, Inc).

Direct Effects

The direct effect in this study is the economic activity generated by the industry itself. Because the industry is so diverse, the direct effects were quantified in four distinct classifications. These are: private veterinary practices and clinics, private industry veterinarians, government veterinarians, and academia.

Private Veterinary Practices and Clinics

Private veterinary practices and clinics dominate the veterinary medicine industry in Minnesota. Of the 2,001 licensed veterinarians in Minnesota, the vast majority practice in this field. Membership of the Minnesota Veterinary Medical Association reveals that small animal practice is the most common, with nearly 70 percent of the membership indicating this as their type of practice.

Data on private practices and clinics is available in the IMPLAN model under the veterinary services industry. The veterinary services industry includes: animal and pet hospitals, labs, testing and inspecting services, internists and surgeons, vaccinations, and practices and

clinics for both large and small animals. It does not include research and development, grooming, animal breeding and horse boarding, or transportation of pets.

According to the model, the veterinary services industry in Minnesota in 2010 had 7,700 employees. The 7,700 employees of private practices and clinics include veterinarians, veterinary technicians, and other office staff. The Minnesota Board of Veterinary Medicine (state licensing board) reports 2,001 veterinarians with active licenses and Minnesota addresses. A Minnesota veterinary license is required to practice in the state. As detailed later in this report, not all licensed veterinarians work in private clinics or practices. It is estimated that 1,800 veterinarians are employed by private practices and clinics.

The Minnesota Veterinary Medicine Association, which offers certification to veterinary technicians, reports 2,385 certified veterinary technicians in the state. The certification is voluntary, so there are likely many additional veterinary technicians working in Minnesota.

Table 1 details the breakdown of employment in the veterinary services industry by veterinarians, certified veterinary technicians, and other employees.

Licensed Veterinarians	1,808
Certified Veterinary Technicians	2,385
Other Office Staff - including Veterinary Technicians without Certification	3,507
Total	7,700
Sources: Minnesota Board of Veterinary Medicine, Minnesota Veterinary Medical Association, IMPLAN.	

Table 2 shows the total direct effect of private veterinary practices and clinics in Minnesota. Direct effects include employment, output, and labor income expenditures. The analysis will include both expenditures by the practice/clinic itself for supplies and inputs, and expenditures by its employees via their payroll. This information will be used to calculate the total economic impact of the veterinary medicine industry.

As indicated, there are 7,700 employees in this field. Based on data collected, total labor income for these employees was an estimated \$350 million in 2010. Total industry output was an estimated \$600 million.

Labor income for private practices and clinics was calculated using wage data for each of the three job classifications¹. Veterinarians (1,800 employees) were assumed to earn \$97,000 annually based on available data, for an estimated industry total of \$175 million. Veterinary technicians (2,385 employees) were assumed to earn \$35,000 annually, for an estimated industry total of \$80 million. Finally, all other employees were assumed to earn \$25,000 annually, for an estimated industry total of \$90 million.

Total output for the industry used in this analysis is based on the IMPLAN data and adjusted for the labor income as calculated by researchers.

Table 2: Estimated Direct Effect of Private Veterinary Practices and Clinics, Minnesota 2010	
Employment	7,700
Output (millions)	\$600
Labor Income (millions)	\$350
Estimates by the Extension Center for Community Vitality and the Department of Applied Economics	

¹ Data from the Occupational Employment and Wages tool available from the Minnesota Department of Employment and Economic Development. <http://www.positivelyminnesota.com>.

Private Industry Veterinarians

Private companies and businesses also employ veterinarians. As noted, private industries such as pharmaceutical manufacturers, vaccine manufacturers, and research and development companies, often hire veterinarians to work in their laboratories. In Minnesota, the medical device industry employs veterinarians. These veterinarians are typically highly skilled and well-compensated.

According to the American Veterinary Medical Association, there are 80 veterinarians employed in private industry in Minnesota. While direct wage and benefit data is not available for these veterinarians, labor market information from the Department of Employment and Economic Development indicates that veterinarians in the upper 90 percent of wage earners make \$73 an hour, or for a full-time position, \$151,840 annually. Given researcher conversations with private industry veterinarians, this is likely a conservative estimate.

Estimated direct effects of private industry veterinarians used in this analysis are shown in table 3. Given that private industry veterinarians work primarily for an industry not related to veterinary medicine, the economic impact of these veterinarians is limited to the expenditure of their income. This analysis will not include any expenditure for supplies or inputs into their work.

Table 3: Estimated Direct Effect of Private Industry Veterinarians, Minnesota 2010	
Employment	80
Labor Income (millions)	\$ 16
Estimates by the Extension Center for Community Vitality and the Department of Applied Economics	

Government Veterinarians

According to Fedscope, an online government database, there are 68 federal veterinarians working in Minnesota. Their average salary is

\$80,883. Thus, the total estimated labor income for federal veterinarians is \$5.5 million.

Based on interviews with employees of state agencies and on publically available state government information, there are 29 veterinarians employed by the state of Minnesota. Their wages are public information. In total, they were paid an estimated \$2.9 million in compensation in 2010.

Estimated direct effects of government veterinarians used in this analysis are shown in table 4. Like their colleagues in private industry, government veterinarians work primarily for causes not related to the veterinary medicine industry. Therefore, this analysis will include their salaries in the economic impact, but will not include expenditures made for inputs into their work.

Employment	97
Labor Income (millions)	\$ 8
Estimates by the Extension Center for Community Vitality and the Department of Applied Economics	

Academia

The College of Veterinary Medicine has 785 employees. They paid \$50.4 million in labor income to their employees in fiscal year 2011. The College made a total of \$107 million in expenditures.

According to a survey conducted by researchers, veterinary technician programs employ 54 individuals. Just over a third of those employees are veterinarians and the remaining are veterinary technicians. Based on publically available information, researchers estimate that these employees were paid \$3.4 million in compensation in 2010. Direct effects of academia used in this analysis are shown in table 5.

Employment	840
Output (millions)*	\$ 110
Labor Income (millions)	\$ 50
*Output here is equivalent to expenditures by the College of Veterinary Medicine.	
Estimates by the Extension Center for Community Vitality and the Department of Applied Economics	

Indirect and Induced Effects

Now that the direct effects are quantified, the data can be entered into an input-output model. Input-output models trace the flow of dollars throughout a local economy and can capture the indirect and induced, or ripple effects, of an economic activity. The input-output modeling software and data from IMPLAN (MIG, Inc) was used in this report.

Indirect effects are those associated with a change in economic activity due to spending for goods and services. In this case, these are the changes in the local economy occurring because veterinarians and others in the veterinary medicine industry need to purchase materials (vaccines, bandages, office supplies, and electricity, for example) and related services (accounting, advertising, etc.). These are business-to-business effects.

Induced effects are those associated with a change in economic activity due to spending by the employees of businesses (labor) and by households. Primarily, in this study, these are economic changes related to spending of income by veterinarians, veterinary technicians, and others employed by the industry. These are business-to-consumer effects.

Total Effects

Total

The total economic contribution of the veterinary medicine industry in Minnesota is an estimated \$1.5 billion, including an estimated \$680 million in wages and salaries paid to Minnesota workers. As a result of the industry's presence in Minnesota, an estimated 14,500 individuals have employment. See table

reflects the relatively high wages paid to veterinarians.

The total economic contribution is derived from four sub-classifications of the industry, as detailed in the direct effect section of this report.

Private Veterinary Practices and Clinics

Directly, private practices and clinics employed 7,700 people in 2010. As a result of spending

Table 6: Estimated Total Economic Contribution of the Veterinary Medicine Industry, Minnesota, 2010

	Direct	Indirect	Induced	Total
Output (millions)	\$750	\$190	\$570	\$1,500
Employment	8,800	1,200	4,500	14,500
Labor Income (millions)	\$430	\$60	\$190	\$680

Estimates by the Extension Center for Community Vitality and the Department of Applied Economics

6 for more detail.

In order to create this output, private businesses and government employed an estimated 8,800 workers and paid an estimated \$430 million in labor income.

The majority of the veterinary medicine industry's additional contributions to the state economy are driven by employee spending. Induced employment impacts are over 3.5 times the indirect effects. This is partially due to the modeling of this study, including the wages and salaries only for private industry and government veterinarians. However, it also

by the practices and clinics, and their employees, an additional 4,600 jobs were supported in the state, see table 7.

In total, private practices and clinics contributed \$1.2 billion to Minnesota's economy in 2010. This included \$550 million in labor income payments to Minnesota's workforce. This makes the private practices and clinics industry the largest single contributor to the economic contribution of the veterinary medicine industry in Minnesota, accounting for 80 percent of the total contribution.

Table 7: Estimated Total Economic Contribution of Private Veterinary Practices and Clinics, Minnesota, 2010

	Direct	Indirect	Induced	Total
Output (millions)	\$600	\$180	\$420	\$1,200
Employment	7,700	1,200	3,400	12,200
Labor Income (millions)	\$350	\$60	\$140	\$550

Estimates by the Extension Center for Community Vitality and the Department of Applied Economics

Private Industry Veterinarians

Minnesota's private companies and corporations employed an estimated 80 veterinarians in 2010. As a result of their employment, a total of 220 jobs were supported in the state.

The employment of veterinarians by private companies contributed an estimated \$37 million in output to the economy in 2010. This included \$22 million in labor income.

Table 8: Estimated Total Economic Contribution of Private Industry Veterinarians, Minnesota, 2010

	Direct	Indirect	Induced	Total
Output (millions)	\$21	\$0	\$16	\$37
Employment	80	0	140	220
Labor Income (millions)	\$16	0	\$6	\$22
Estimates by the Extension Center for Community Vitality and the Department of Applied Economics				

There are no indirect effects in this analysis, because only veterinarians' wages and benefits were included as direct effects, and labor income, by definition creates induced effects.

Government Veterinarians

Veterinarians employed in state and federal government positions contributed an estimated \$24 million of output to the state's economy in 2010. To produce this output, 180 jobs were supported and \$12 million in labor income was paid to those workers.

Table 9: Estimated Total Economic Contribution of Government (Federal and State) Veterinarians, Minnesota, 2010

	Direct	Indirect	Induced	Total
Output (millions)	\$14	\$0	\$10	\$24
Employment	97	0	80	180
Labor Income (millions)	\$8	\$0	\$4	\$12
Estimates by the Extension Center for Community Vitality and the Department of Applied Economics				

Academia

Finally, the education and training of veterinarians and veterinary technicians contributes to the economy. In 2010, the College of Veterinary Medicine at the University of Minnesota and thirteen private and public colleges training veterinary technicians employed 930 workers. Their employment contributed an estimated \$230 million in output and 1,830 jobs to the state's economy.

Table 10: Total Economic Contribution of Veterinary Medicine Academia, Minnesota, 2010

	Direct	Indirect	Induced	Total
Output (millions)	\$110	\$3	\$120	\$230
Employment	930	20	900	1,830
Labor Income (millions)	\$54	\$0.9	\$40	\$95
Estimates by the Extension Center for Community Vitality and the Department of Applied Economics				

NOTES ON THE ANALYSIS

This report is modeled after similar studies done in Michigan and Texas.

This study was completed using economic contribution analysis methodology. Economic contribution analysis quantifies the amount of economic activity generated by a project or industry. Economic contribution studies differ slightly from the methodological viewpoint of economic impact studies. Economic impact studies require a “*but for*” test to be met. If, but for, the industry, what would the economy look like? Clearly, this type of analysis would not be feasible for the veterinary medicine industry. It is difficult enough to contemplate an economy without veterinary medicine, and even more difficult to try and model one.

Accounting for the number of veterinarians in the state is a complicated task. While all veterinarians are required to be licensed to practice, the state licensing board does not track where the veterinarians are employed or what type of medicine they practice. The Minnesota Veterinary Medical Association does some tracking of its membership, but membership is voluntary and their membership categories do not align perfectly with the categories used in this report. Government veterinarians are employed in a number of agencies. Some of them, although performing veterinary medicine as part of their job responsibilities, do not have veterinary titles, making them difficult to identify.

Further, information on total wages and benefits paid to private industry employees is difficult to obtain. While government and education data is generally considered public information, compensation for veterinarians in private practices/clinics and in private industry is not. This analysis uses data from the Occupational Employment and Wages tool to estimate wages for privately practicing veterinarians and veterinarians employed by private industry. The data is primarily wage data and does not include all types of benefits.

Therefore, the estimate of labor income for these two industries is a conservative estimate.

Finally, this analysis focuses on backwards linkages, or on the suppliers to the veterinary medicine industry and its employees. It does not look forward to measure the impact on the economy of having veterinary services. For example, the analysis does not measure the value of having healthy livestock. This is in keeping with input-output theory. Further, economic theory would indicate that in certain cases, the value of these forward linkages are captured into the salaries earned by veterinarians, veterinary technicians, and other related staff.

CONCLUSIONS

The practice of veterinary medicine has a long history in Minnesota, dating back to the early years of statehood. The industry of veterinary medicine has evolved and expanded since the late 1800's. While many veterinarians are still practicing in the field of animal agriculture, veterinarians in Minnesota are now involved in a diverse set of activities. Given the diverse nature of the industry, the College of Veterinary Medicine and the Minnesota Veterinary Medical Association posed the question "What is the economic contribution of the veterinary medicine industry in Minnesota?" To answer this question, the College and the Association partnered with University of Minnesota Extension's Economic Impact Analysis program and with the Department of Applied Economics.

The total economic contribution of the veterinary medicine industry in Minnesota is an estimated \$1.5 billion, including an estimated \$680 million in wages and salaries paid to Minnesota workers. As a result of the industry's presence in Minnesota, an estimated 14,500 individuals have employment.

In order to create this output, private businesses and government employed 8,800 workers and paid an estimated \$430 million in labor income.

The majority (80 percent) of the industry's contribution is generated by private veterinary practices and clinics. The 7,700 employees of private veterinary practice and clinics contributed an estimated \$1.2 billion in economic output to the state in 2010. The most common type of private practice/clinic is focused on small-animal veterinary medicine.

Veterinary clinics and practices are concentrated in highly-populated areas of state. However, high concentrations can be found in areas where animal agriculture is intensive, such as the dairy producing region of central Minnesota and the hog growing region of southern Minnesota. Veterinary clinics and practices are located in every region of the state.

Private industry and government veterinarians contribute to the state economy via the expenditure of the income they earn practicing their trade. There were an estimated 80 private industry veterinarians in Minnesota in 2010. They generated an estimated \$37 million in economic activity. There were 97 government veterinarians who generated an estimated \$24 million in economic activity.

A final component of the veterinary medicine industry is academia. The education of veterinarians and veterinary technicians contributed an estimated \$230 million in economic output to the state in 2010. This includes an estimated \$95 million in labor income. Educational institutions employed 930 individuals to carry out their mission.

APPENDIX 1: METHODOLOGY

Special models, called input-output models, exist to conduct economic impact analysis. There are several input-output models available. IMPLAN (IMpact Analysis for PLANning, Minnesota IMPLAN Group)² is one such model. Many economists use IMPLAN for economic contribution analysis because it can measure output and employment impacts, is available on a county-by-county basis, and is flexible for the user. IMPLAN has some limitations and qualifications, but it is one of the best tools available to economists for input-output modeling. Understanding the IMPLAN tool, its capabilities, and its limitations will help ensure the best results from the model.

One of the most critical aspects of understanding economic impact analysis is the distinction between the “local” and “non-local” economy. The local economy is identified as part of the model-building process. Either the group requesting the study or the analyst defines the local area. Typically, the study area (the local economy) is a county or a group of counties that share economic linkages. In this study, the study area is the entire State of Minnesota with a focus on Greater Minnesota.

A few definitions are essential in order to properly read the results of an IMPLAN analysis. The terms and their definitions are provided below.

Output

Output is measured in dollars and is equivalent to total sales. The output measure can include significant “double counting.” Think of corn, for example. The value of the corn is counted when it is sold to the mill, again when it is sold to the dairy farmer, again as part of the price of fluid milk, and yet again when it is sold as cheese. The value of the corn is built into the price of each of these items and then the sales of each of these items are added up to get total sales (or output).

² IMPLAN Version 3.0 was used in this analysis. The trade flows model with SAM multipliers was implemented.

In this analysis, the main source of output is measured from private veterinary clinics and practices and from academia. Labor income is a component of output, so the income from private industry veterinarians and government veterinarians is included in output, as well.

Private clinics and practices produce output in the very classic sense. Total sales of the services provided equals output. In academia, there are no sales per say. In this case, output is measured as total expenditures made by the University. Since, in input-output accounting, sales must equal expenditures.

Employment

Employment includes full- and part-time workers and is measured in annual average jobs, not full-time equivalents (FTE's). IMPLAN includes total wage and salaried employees, as well as the self-employed, in employment estimates. Because employment is measured in jobs and not in dollar values, it tends to be a very stable metric.

Labor Income

Labor income measures the value added to the product by the labor component. So, in the corn example when the corn is sold to the mill, a certain percentage of the sale goes to the farmer for his/her labor. Then when the mill sells the corn as feed to dairy farmers, it includes some markup for its labor costs in the price. When dairy farmers sell the milk to the cheese manufacturer, they include a value for their labor. These individual value increments for labor can be measured, which amounts to labor income. Labor income does *not* include double counting.

Direct Impact

Direct impact is equivalent to the initial activity in the economy. In this study, it is spending by telecommunication companies on operations, wages and salaries, and capital improvements.

Indirect Impact

The indirect impact is the summation of changes in the local economy that occur due to

spending for inputs (goods and services) by the industry or industries directly impacted. For instance, if employment in a manufacturing plant increases by 100 jobs, this implies a corresponding increase in output by the plant. As the plant increases output, it must also purchase more inputs, such as electricity, steel, and equipment. As the plant increases purchases of these items, its suppliers must also increase production, and so forth. As these ripples move through the economy, they can be captured and measured. Ripples related to the purchase of goods and services are indirect impacts. In this study, indirect impacts are those associated with spending by private practices and clinics and academia for goods and services used in their operations.

Induced Impact

The induced impact is the summation of changes in the local economy that occur due to **spending by labor**. For instance, if employment in a manufacturing plant increases by 100 jobs, the new employees will have more money to spend to purchase housing, buy groceries, and go out to dinner. As they spend their new income, more activity occurs in the local economy. Induced impacts also include spending by labor generated by indirect impacts. So, if the private veterinary clinics and practices purchase services from a tax preparation firm, spending of the tax preparer's wages would also create induced impacts. In this study, the induced impacts are those economic changes related to spending by veterinarians, veterinary technicians, and support staff employed in private practices and clinics and academia.

Total Impact

The total impact is the summation of the direct, indirect, and induced impacts.

Input-Output, Supply and Demand, and Size of Market

Care must be taken when using regional input-output models to ensure they are being used in the appropriate type of analysis. If input-

output models are used to examine the impact or the contribution of an industry that is so large that its expansion or contraction results in such major shifts in supply and demand that prices of inputs and labor change, input-output can overstate the impacts or contributions. While the veterinary medicine industry is a major component of the Minnesota economy, it is not likely that its existence has an impact on national prices. Hence, the model should estimate the contributions reliably.