

A New Health Care Delivery System and the Economics of Utilizing Veterinary Technicians

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Abstract

Population growth, global transformations, technological advances, and changing societal concerns on food production are inevitable and are challenging the way we produce food. Increasing global demand for animal products in the developing world, along with rapid urbanization, increasing energy costs, decreasing availability of quality arable land as well as water quality issues, place additional constraints on current food animal production systems. Indeed, the generational challenge to emerging food animal veterinary students is “how to feed the growing world without destroying the environment”. The future food animal health care system and the veterinary professionals serving within will have to adapt to these changes in a manner that advances societal needs and meets demands in a responsible manner. To be relevant problem solvers in this global challenge, future veterinarians must be trained in diverse disciplines (epidemiology, management, ecology, economics, production systems, environmental sciences, nutrition) and even more importantly, have the ability to formulate integrated solutions to these complex challenges.

Résumé

Plusieurs facteurs inévitables remettent en question notre façon de produire les aliments. Citons par exemple la croissance de la population, les transformations dues à la mondialisation, les progrès technologiques et les inquiétudes de la société concernant la production des aliments. Des contraintes pèsent aussi sur nos systèmes actuels d'élevage d'animaux destinés à l'alimentation: la demande croissante en produits animaux des pays en développement, l'urbanisation accélérée, la hausse des coûts de l'énergie, la raréfaction des bonnes terres arables et les problèmes de qualité de l'eau. En fait, le défi de génération auquel feront face les futurs vétérinaires d'animaux de ferme est celui-ci: «Comment nourrir le monde en pleine croissance sans détruire l'environnement?» Le système de santé des animaux destinés à l'alimentation et les vétérinaires qui en font partie devront s'adapter à ces changements pour répondre aux besoins et aux demandes de la société d'une

manière responsable. Pour résoudre avec pertinence les problèmes de cette évolution mondiale, les futurs vétérinaires doivent être formés en disciplines diverses (épidémiologie, gestion, écologie, économie, systèmes de production, sciences environnementales, nutrition). Plus important encore, ils devront formuler des solutions intégrées à ces défis complexes.

Introduction

Veterinary medicine is under continual evolution as the relationship between man and animals evolves over time. Domestication of livestock is perhaps one of the greatest achievements of mankind,⁵ and its subsequent success reflects advancement in a number of scientific disciplines including veterinary medicine. In fact, the first organized veterinary school was developed in 1761, at Lyons, France largely in response to cow plague that was devastating Europe and destroying the emerging economy. Since then, the profession has played a pivotal role in the control of many devastating diseases, which in turn along with the availability of relatively cheap energy, has allowed the evolution of intensive high yielding forms of animal agriculture enjoyed in the developed world. In addition to control of traditional disease issues, with these changes we have seen the emergence of new challenges, thus broadening the nature of problems our profession must confront. Over the last 30 years, the veterinary profession has recognized the role of management in addition to disease as an important modulator of production efficiency. Health in the food animal context is not only the maintenance of normal biological processes but also the attainment of production goals in an economically efficient manner. Ill-conceived herd management strategies in reproduction, nutrition, milking management, and heifer rearing can often be more damaging to the economic success of an operation than the effects of traditional infectious/metabolic diseases. Furthermore, with the advent of intensive agriculture, society has growing concerns regarding the environmental impact, as well as animal welfare issues in all forms of production. Our profession needs to focus on the responsible production of healthy safe foods from healthy cows in healthy herds in a manner that promotes environmental responsibility (Figure 1).

The challenge of our food animal veterinary profession is to anticipate the inevitable global and structural changes that will influence the way in which we produce food and identify the contributory role that veterinary medicine can play in ensuring its success. Indeed, the ultimate challenge to emerging generations of food animal veterinarians is how to produce safe and wholesome products at affordable prices to the world's growing population without destroying the environment in the process (Figure 1).

The veterinary health care system must effectively offer services that help the diverse animal production systems produce safe, economically affordable food products from healthy, well-cared-for cows on herds that have a positive impact on the local economy and are ecologically sound in terms of their use of resources. In short, the system must be able to meet the immediate health needs of food animals, the producer's need for a production process that provides a competitive economic reward for the associated production risk, and meets society's short and long term goals. Food production is global activity that is affected by a number of factors. The purpose of this paper is to identify global as well as infrastructural changes that are occurring in dairy production and to propose a new model of veterinary health care delivery that will meet these challenges.

Global Transformations

The growing world population is estimated to exceed 9 billion in 40 years, creating a dramatic need for increased food production. Most of the growth in demand for animal protein is expected to come from the "livestock revolution" occurring in the developing world⁴ and will certainly reshape regional dietary patterns

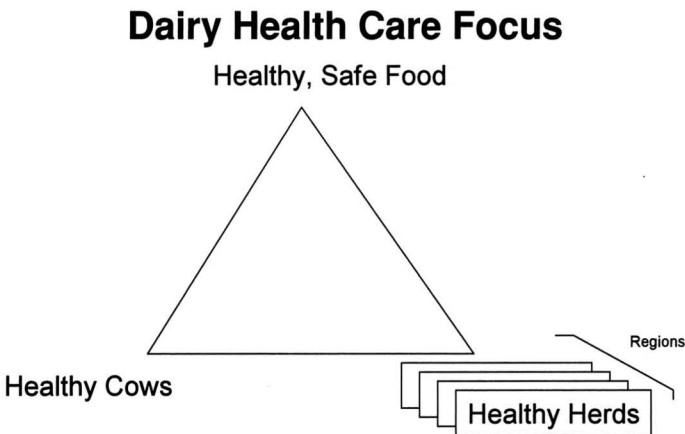


Figure 1. The dairy health care focus has been broadened to include not only healthy cows, but production of healthy and safe food produced in healthy herds in healthy environments.

as well as having direct local environmental impacts. Animal products not only provide nutritious protein and add great diversity to our overall diet, but play a pivotal role in influencing political and social change.

Urbanization is occurring globally, where approximately 185,000 people join the global urban population on a daily basis²² and it is estimated that 84% of the population in the developed world will live in an urban environment in 2030. We are living in a period of the largest migration of people to the urban centers in the history of the world, forever changing the rural community. This change reflects the long-term historical trend of societies in reducing the population that deals directly with food production. Urbanization trends in general present difficulties in maintaining veterinary services as well as human medical services in vast regions of the country.¹¹

Developing countries are in varying degrees of transition with combinations of extensive, low yielding animal production systems along with intensive, energy consuming systems geared to meet the market demands of an exploding urban population. Dramatic improvements in alleviating poverty have occurred over the last 50 years. However, world hunger still remains the preeminent challenge for many developing nations and is certainly a moral obligation of the developed world. Hunger related diseases claim more lives globally than AIDS, malaria, and tuberculosis combined.² The Food and Agriculture Organization of the United Nations has estimated that nearly a billion people around the world are considered to be under-nourished,²¹ a human catastrophe. Furthermore, our growing global population will require an estimated 100% increase in food production in the next 50 years.¹⁷ Even more alarming, this additional food production must come with only a 1% increase in available cropland.¹⁷ This challenge must be met by embracing production methodologies that maximally use available local resources, improve energy efficiency on all levels of the food production chain, and ensure that the systems are environmentally sustainable.¹⁹

Social Changes

The history of animal agriculture is a story of man's adaptation and implementation of new knowledge in the production of food. Technical advances in all fields of science have either directly or indirectly affected our ability to produce food. The history is compelling and a testimony to man's ability to solve problems. The predictions of massive starvation by Malthus and others failed to achieve fruition due to an underestimation of man's ingenuity.²⁰ This evolution has also been influenced by the value ascribed by society to the use of the resources of production as opposed to alternative uses (Figure 2). Resources have multiple uses, and society, by ascribing

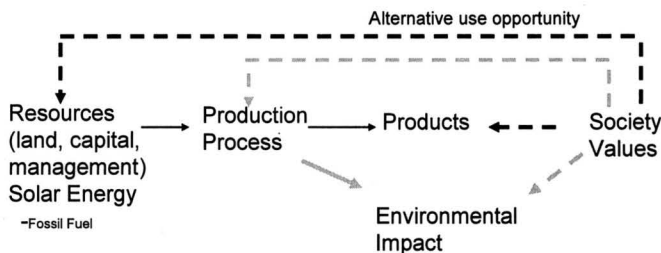
value to the end products as well as the resources themselves, indirectly suggests how these resources should be used. Alternative uses are always in competition for resources and provide a mechanism by which the societal desires for various products become reality.

In addition to the value ascribed to actual yield (of milk, meat etc.) and their direct attributes (quality, safety, affordability), societies are also concerned about the impact of the production process itself on the environment and on animal welfare. High yielding production systems effectively reduce animal maintenance cost and thus reduce the amount of pollutant/lb of product³ (Milk Intensity Visual Analytic at <http://www.dgalligan.com/milkintensity.html>). However, these systems concentrate animals and their manure, creating local environmental issues if they are not properly managed.

Dairy production is a complex process with a variety of production strategies to fit local conditions and availability of resources. Globally, it is a diversified production system. The dairy cow, being a non-selective ruminant, has the unique ability to utilize the nutrients in a variety of feedstuffs that other species, including humans, cannot digest. It is estimated that 50% of the solar energy in cereal and seed crops is in the straw and stover part of the plant which is inedible by humans, but potentially digested by ruminants.²³ They are an important part of the world food chain ecology and can use feed inputs that do not directly compete with human consumption.

To be relevant to the emerging diversity of animal production systems, our profession can no longer limit its domain to dealing solely with disease issues of food animals, but must responsibly recognize the broader interests of society. We must understand how to design production systems that meet the diverse, sometimes conflicting, objectives of society in a manner that is based on the results of rigorous scientific investigation.

Animal Production Process



Modified from McInerney, 2004

Figure 2. Society valuation of products and the animal production process. Modified from McInerney, 2004.

Intensive as well as extensive production systems have their issues; we as a profession must be objective and utilize the best methodologies from both systems in a manner that meets society's long-term goals.

General Features of the Dairy Industry

A number of trends have shaped and will continue to shape US agriculture as well as the role of the servicing veterinarian.⁷ The dairy industry, as all animal production industries worldwide, has undergone considerable consolidation over the years. The two major strategies that have been pursued are improving animal yield per year and increasing herd size (Figure 3). Increasing the yield per cow (estimated to be growing at about 1.7% growth per year) is economically rewarding (diluting animal maintenance and replacement cost) and has been a strategy pursued by the industry from its inception. In the US, total dairy cow numbers have greatly decreased, declining from a high of 22 million cows in 1950 to approximately 9 million in 2008. Herd size has increased at an annual rate of nearly 5% per year for the last 10 years, allowing bigger operations to purchase inputs in larger volumes and ultimately spread overhead costs over more units of product. In short, the US dairy industry produces more milk than ever with fewer cows. A number of technological advances, as well as the long-term goal of reducing labor by capital investments, have contributed to these changes.

As a consequence of these mega trends, the traditional "patient" and client pool size in the dairy sector has been greatly reduced. As herds have consolidated,

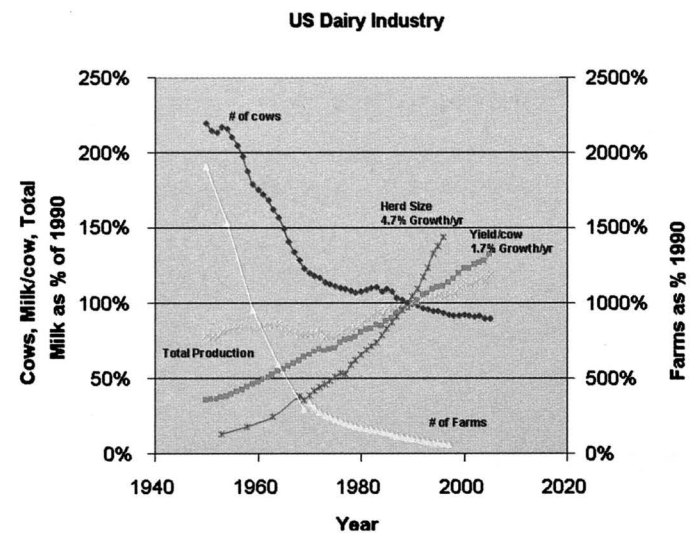


Figure 3. Demographic changes in the US dairy industry normalized to 1990 values (modified from Salman *et al*¹⁶).

on-farm personnel are often trained in the delivery of primary health care to the individual cow. As the management of dairy cows becomes more regimented, their health issues are more predictable and lend themselves to structured responses. Many herds, with mature cow populations exceeding 500, see various health issues on a routine basis and in response have established protocols for on-farm personnel to follow. In these situations, the veterinarian may be involved at the development and evaluation of herd health protocols, rather than the actual delivery of primary health care. They take on responsibilities that affect overall herd economic performance as well as addressing societal concerns on animal welfare and environmental impact. Skills in epidemiology, nutrition, management, economics and quantitative assessment become vital in effectively serving in this new role.

Conversely among pastoral farmers in many developing countries, animal value and widely dispersed populations make support of a private veterinary practice infeasible. In these environments, use of Community Animal Health Workers, supervised by a

regional veterinarian, has made primary health care affordable, accessible, and successful. Effective control of epizootic disease and recurrent animal diseases has made these systems successful. A stumbling block has been monopolistic veterinary regulation and active veterinary opposition, rather than veterinary supervision and guidance.²⁴

Who Should Provide Care and Emerging Technologies?

The issue of what health issues should be serviced by the veterinarian versus a technical staff member (or a technical test) can be broadly modeled as a decision choice between two health intervention strategies. The treatment of an event (health issue) by a veterinarian will certainly cost more (due to educational expenses) and expectedly have a higher degree of success than if the treatment was administered by a less highly trained individual. Madison *et al*¹² and Fetrow *et al*⁸ suggested a decision tree model (Figure 4) to look at the underlying parameters which might influence the preference of one

Two Way Decision Tree

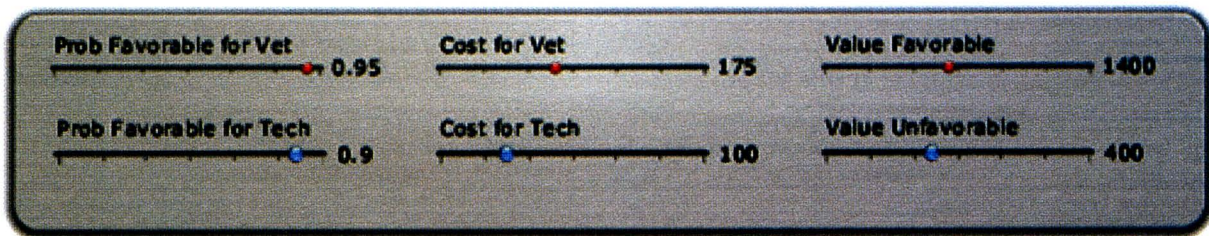
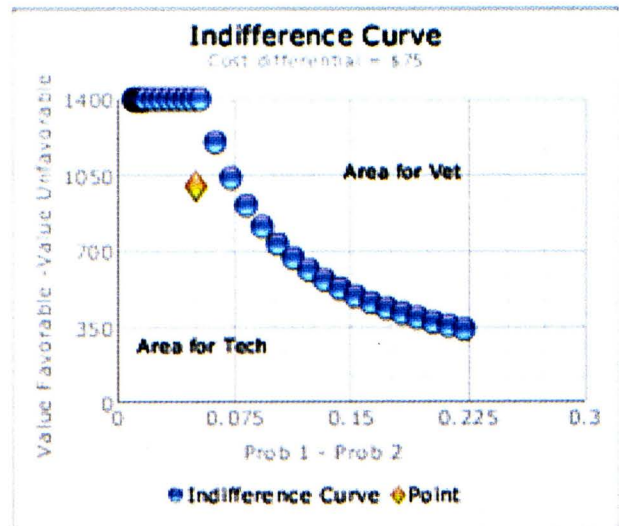
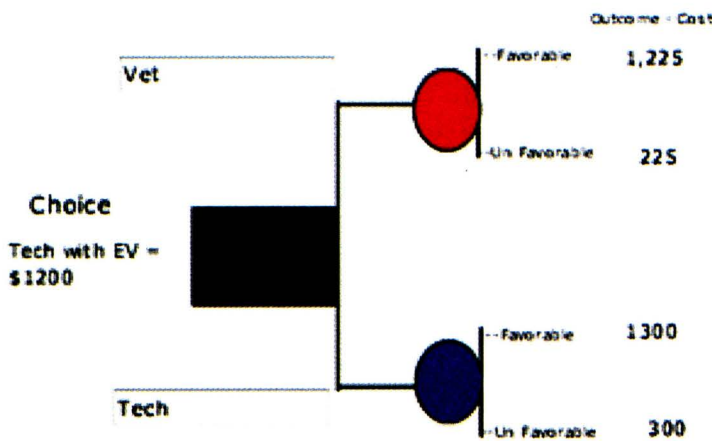


Figure 4. Basic decision tree application⁸ applied to the veterinarian (Vet) versus technician (Tech) treatment of a health issue.

intervention strategy over another, which structurally applies to the more general question we have posed as to who should provide primary care.

In this model, the underlying parameters (cost, probabilities, and outcome values) can be arranged to create an indifference curve which defines the level of the parameters needed so that the decision choices (veterinarian vs. technician intervention) are of equal value.

The indifference curve is indicated by the following equation:

$$\text{Value}_{\text{Favorable}} - \text{Value}_{\text{Unfavorable}} = (\text{Cost}_{\text{Vet}} - \text{Cost}_{\text{Tech}}) / (\text{Prob}(S)_{\text{Vet}} - \text{Prob}(S)_{\text{Tech}})$$

Where,

$\text{Value}_{\text{Favorable}}$ is the value of the animal after a successful outcome,

$\text{Value}_{\text{Unfavorable}}$ is the value of the animal after an unsuccessful outcome,

Cost_{Vet} is the cost of the intervention done by the veterinarian,

$\text{Cost}_{\text{Tech}}$ is the cost of the intervention done by the technician,

$\text{Prob}(S)_{\text{Vet}}$ is the probability of a successful outcome by the veterinarian intervention,

$\text{Prob}(S)_{\text{Tech}}$ is the probability of a successful outcome by the technician intervention.

In the example presented, a probability of success differential of 5% (probability of veterinary success 95% versus a probability of technician success of 90%), a cost differential of \$75 dollars between the cost of a veterinarian vs technician (\$175 vs \$100), and for a value of success versus failure of \$1000 (healthy cow purchase (\$1,500 vs cull price), suggest that a technician intervention might be more economically advantageous.

As the cost differential increases (ie cheaper alternative treatments) or the probability of success differential decreases (higher success with alternative treatments), the opportunity space for the technician approach is expanded (area below the indifference curve). New technologies as well as the fact that many clinical activities can be systematized and delegated for implementation by technicians will encourage expansion of this area. The health care approach to the left displaced abomasum in dairy cattle has an interesting and illustrative history of this evolution. In the 1970s it was a novel diagnosis, and most cases were handled by surgeons in veterinary hospitals with the afflicted animals transported to the hospitals. In the 1980s, methods were developed by which the cases could be handled by practicing veterinarians in the field environment with a relatively high degree of success. More recently, the toggle system, proposed by Sterner *et al*¹⁸ now allows technical staff to perform the procedure with comparable success rates to veterinarians. Other medical professions have seen this evolutionary trend, where technical

specialists now do a lot of the actual clinical activities as part of an integrated health care network.

The Dairy Health Care Dollar – Potential Role of Technicians

To deal with the narrowing profit margins in animal production systems, increasing cost of veterinary education, structural changes in animal production industries, and emerging concerns regarding biosecurity, new health care delivery systems have been postulated for food animal production systems.^{14,24} Basically, these health care systems involve the use of a veterinarian, trained in epidemiology and management, overseeing a group of technically trained individuals (para-professionals, community-based animal health care workers) who actually deliver primary health care at the individual animal level. The degree of oversight as well as the dimensions of clinical activities will vary from country to country, reflecting governmental legislation as well as the practical needs of the local animal industries.²⁴ New technologies, increasing the ability to communicate with audio and visual modalities virtually worldwide, are redefining the meaning of “oversight”.

Herds typically spend an estimated \$66-72 per cow, per year in veterinary-associated costs (Dairy Farm Operating Trends, September 30, 2008, Moore, Stephens, Wurth, Farzer, and Torbet, LLP). A 2006 Northeast Dairy Farm Summary⁶ reported veterinary, medicine, and breeding costs ranging between \$129 to \$182 per cow, per year depending on herd size. These costs in general represent the amounts of money allocated for health issues (drugs and services) in dairy cows. Depending on the proportion used for purchasing pharmaceuticals, the remainder can be used for the provision of health services (veterinarian, technician). To be embraced by the dairy industry, a new proposed health care system must operate under these economic boundaries or offer improved health benefits. To look at the potential impact of a new health care system for dairy cows that involves the use of technically trained individuals providing basic health services, a deterministic model was developed in a visual analytic format.

The basic model splits the dairy health care dollar into three components including pharmaceuticals, veterinary, and technical services (Figure 5). The partition of the health dollar into these three dimensions will define the cow populations that can be effectively serviced by a technical pool of individuals with reporting responsibilities to a veterinarian. Inputs to the model at default levels include: veterinary gross income (\$324,857), veterinary salary (\$109,152) as a % of gross income (33.6%), technician salary (\$50,000), cows serviced per technician (3,000), total annual health care expenditure per cow (\$100), and total pharmaceutical cost per cow

Health Care Cost

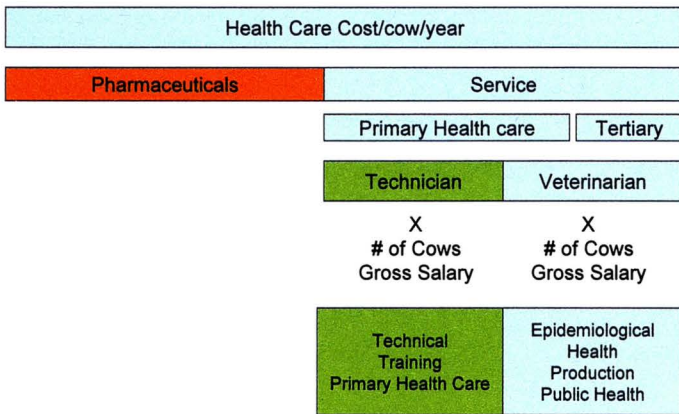
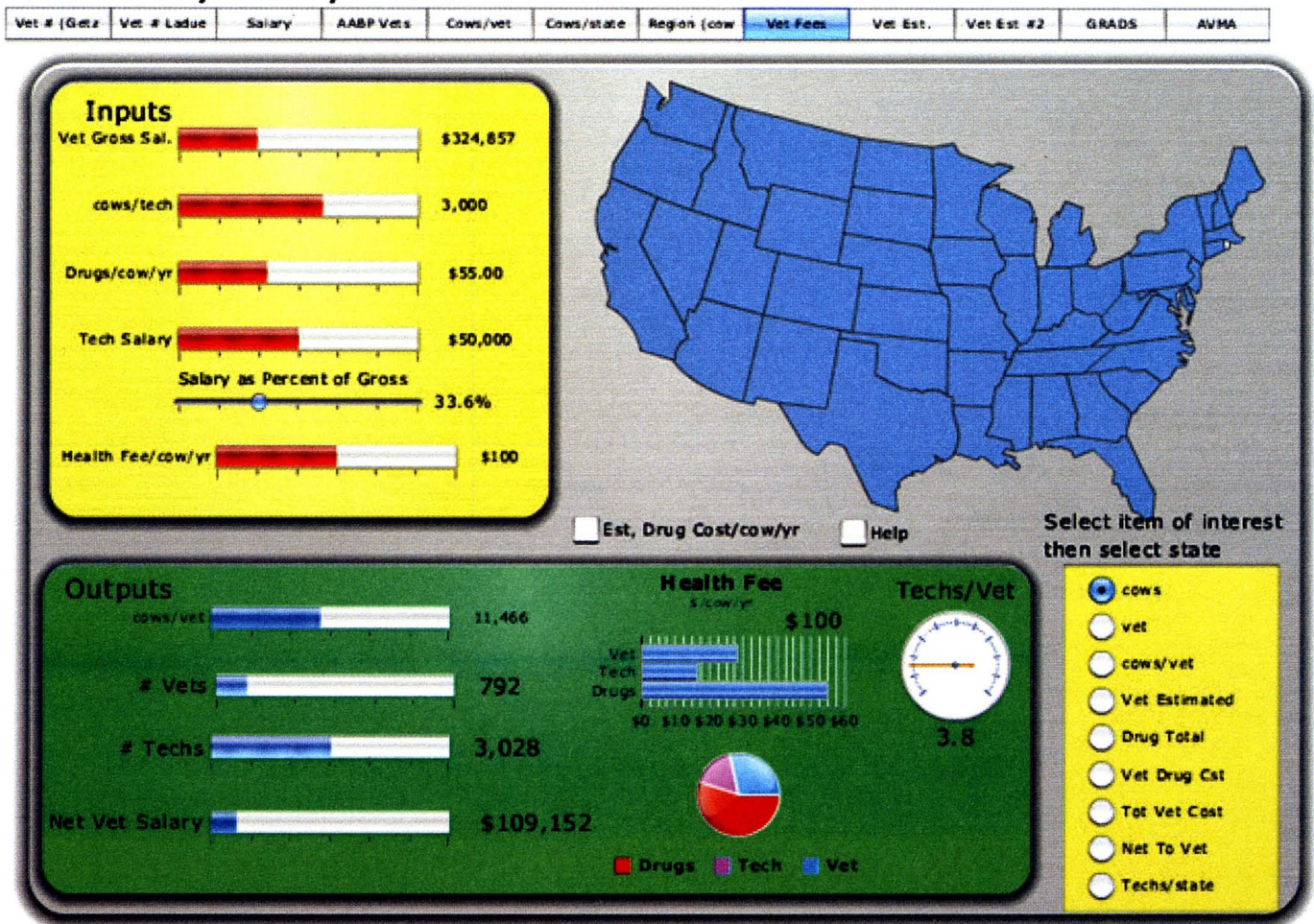


Figure 5. Splitting the dairy health care dollar.

per year (\$55.00). Outputs from the model estimate the number of cows serviced per veterinarian as well as a partitioning of the total annual health care dollars per cow into the three fundamental components (pharmaceuticals, technical salary, and veterinary salary). It also estimates, based on the US dairy cow population, total number of veterinary practitioners (792) and technicians (3,028) needed, number of cows per veterinarian (11,466) and the average number of technicians per veterinarian needed. The model is in the format of a visual analytic,⁹ which allows the user to explore the effect of changing parameter values by using sliders. Furthermore, the model allows the user to explore these estimates on a per-state basis by selection of the item of interest and moving the pointer over the state of interest (Figure 6). With the entered default levels, it appears that the proposed health care system would dramatically reduce

How many Dairy Vets?



Visual Analytic: Galligan, and Kelly, 2007

Figure 6. A model looking at the use of technical staff to deliver primary health care.

the number of vets needed to service the dairy industry and yet expand the delivery of primary health care at a cost-efficient rate. With proper training, the technicians could greatly increase the animal surveillance capacity for the occurrence of important diseases.

Conclusion

While change is inevitable, our response to it is optional. All professions are in a constant state of evolution as the industry they service responds to global changes. Inaction leads to irrelevance. In the dairy sector, technical as well as structural changes at the industry and global level are redefining the role of the veterinarian from deliverer of primary health care services to a professional who defines herd health protocols, educates, and manages a cadre of technically trained individuals in the actual delivery of fundamental animal care. In this emerging management position, the veterinarian takes responsibilities for factors affecting herd-level efficiencies that directly impact the economic well-being of the operation. In addition and equally important, they become the professional that deals directly with societal concerns regarding animal welfare and the impact of the production system on the environment. Veterinary education must recognize the new role for graduating food animal veterinarians and provide appropriate training that ensures their success in addressing the quintessential worldly problem of feeding the world without destroying the environment.

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