Evaluating Bovine Tuberculosis Risk Communication Materials in Michigan and Minnesota for Severity, Susceptibility, and Efficacy Messages

BRET A. MUTER,1 Department of Fisheries and Wildlife, Michigan State University, 480 Wilson Road, 13 Natural Resources Building, East Lansing, MI 48824, USA
MEREDITH L. GORE, Department of Fisheries and Wildlife, School of Criminal Justice, Michigan State University, East Lansing, MI 48824, USA
SHAWN J. RILEY, Department of Fisheries and Wildlife, Michigan State University, 480 Wilson Road, 13 Natural Resources Building, East Lansing, MI 48824, USA
MARIA K. LAPINSKI, Department of Communication, College of Communication Arts and Sciences, Michigan State University, East Lansing, MI 48824, USA

ABSTRACT Communication programs are a tool available to wildlife managers for managing risks associated with wildlife diseases such as bovine tuberculosis (TB). Evaluating these communication efforts is vital for successful disease management planning; yet, systematic evaluations of wildlife disease-related communication programs are lacking. To this end, we analyzed the content of 41 print and electronic TB risk communication materials (e.g., brochures, handouts, websites) available to stakeholders in Michigan and Minnesota, USA, during April 2010 to 1) describe and compare the materials; 2) make data-based recommendations to improve existing messages; and 3) highlight the ability of the extended parallel process model (EPPM), a well-known health communication theory, to serve as a framework for evaluation of wildlife disease issues. All message components central to the EPPM were identified in our sample of TB risk communication materials. More than 80% of materials promoted behaviors believed to reduce the risks of TB transmission among and between wildlife and livestock in Michigan and Minnesota. Messages conveying severity and susceptibility of TB-related risks were present in 73% and 56% of the materials, respectively; whereas, efficacy messages promoting the ease and effectiveness of recommended behaviors were far less prevalent. Results provide insights for future TB and wildlife disease-related risk communication efforts (e.g., design messages that enhance stakeholder perceptions of efficacy) and demonstrate the utility of the EPPM as a framework to evaluate risk communication materials and messages for wildlife disease-related stakeholders. © 2013 The Wildlife Society

KEY WORDS extended parallel process model, Odocoileus virginianus, persuasion, risk messaging, white-tailed deer, wildlife disease.

Reducing the societal consequences of wildlife disease-related risks to humans and wildlife is an increasingly critical component of contemporary wildlife management (Decker et al. 2010). Communication programs are a tool available to managers for managing risks; such programs can target diverse audiences, address numerous wildlife-related issues, be implemented by diverse stakeholders, and be evaluated using assorted frameworks (Gore et al. 2008). For example, as part of their bovine tuberculosis (TB) management strategies, natural resource, agriculture, and public health agencies in Michigan and Minnesota, USA, use communication campaigns to inform and educate stakeholders (e.g., deer hunters, livestock producers) about TB-related risks and to recommend preventative behaviors (e.g., reducing interactions between livestock and wildlife) individuals can take to help reduce the risk of disease transmission. This communication has occurred through a variety of print and electronic media channels.

Evaluating these communication efforts is vital for successful disease management planning and demonstrates accountability to stakeholders (Gore and Knuth 2009). Decker et al. (2010) noted a better understanding of the content and messages conveyed within wildlife disease risk communication materials may help agencies evaluate their communication efforts, predict stakeholder risk perceptions about wildlife disease, and increase overall effectiveness of wildlife disease management. Yet, systematic evaluations of wildlife disease communication programs are lacking in the extant literature. Evaluation entails primarily 3 systematic activities designed to contribute to the improvement of a
program or policy: description, comparison, and prediction (Rallis and Rossman 2003). Description provides understanding and appreciation of the various aspects of a program so that program quality is evident. Comparisons offer judgments about a program's merit in contrast to an external standard. Prediction gives insight into improving programs or policies, extending them to other sites, increasing funding for them, and terminating them. Evaluative predictions also produce statements about what is working well or poorly and what could be done in the future to improve (e.g., reach more people, be more cost-effective; Rallis and Rossman 2003).

Although education and communication are widely cited as necessary to bolster public support for and achieve policy goals of TB eradication (e.g., Schmitt et al. 2002, Dorn and Mertig 2005), the extent that existing risk communication efforts are advancing the goal of reducing TB-related risks is unknown. To begin addressing this question, we evaluated risk communication materials about TB management in Michigan and Minnesota. Our goals were to 1) describe and compare wildlife disease-related risk communication materials; 2) make data-based recommendations to improve existing messages; and 3) highlight the ability of the extended parallel process model (EPPM), a well-known health communication theory, to serve as a framework for evaluation of wildlife disease issues.

**Bovine Tuberculosis**

Bovine tuberculosis is a chronic, bacterial disease caused by *Mycobacterium bovis* that infects domestic animals, wildlife, and humans around the world (APHIS 2002). Although it was once the most common livestock disease in the United States, TB was eliminated throughout most of the country by the 1970s as a result of a state and federal cooperative eradication program headed by the U.S. Department of Agriculture (Olmstead and Rhode 2004). Discovery of a TB-positive white-tailed deer (*Odocoileus virginianus*) in Michigan in 1975, and then again in 1994, sparked statewide surveillance efforts that identified new TB-infected cattle herds and the country’s first known localized outbreak of TB in free-ranging wildlife (Schmitt et al. 1997). In 2005, several domestic cattle herds and a single wild white-tailed deer in northwest Minnesota were confirmed with TB. Additional TB-positive deer and cattle herds in Minnesota were identified in subsequent years. Despite differences in disease status (TB is only established in deer in Michigan; whereas, in Minnesota, deer are believed to be a spillover host), the 2 states actively engaged in TB eradication activities upon their respective discoveries of the disease (Carstensen et al. 2011).

Occurrence of TB poses social (e.g., Dorn and Mertig 2005, Rudolph et al. 2006), economic (e.g., Buhr et al. 2009), health (e.g., Wilkins et al. 2003), and ecological risks to Michigan and Minnesota’s citizens, livestock, and wildlife. Although TB management is a priority to both states, progress toward eradication has varied considerably (Carstensen et al. 2011). The success of TB management necessitates stakeholder support via adoption of preventative behaviors that help reduce the risk of disease transmission among and between wildlife and livestock (Dorn and Mertig 2005; O’Brien et al. 2006, 2011; Carstensen et al. 2011). Risk communication theory specifies the nature of messages likely to be most influential in motivating risk-reducing behaviors.

**Extended Parallel Process Model**

Health communication campaigns regularly use fear appeals in attempt to motivate adoption of risk-reducing behaviors (e.g., cessation of smoking, drug use, texting-while-driving). Fear appeals are persuasive messages that aim to influence behaviors by stimulating fear—a physiological and emotional response to a salient and serious threat (Easterling and Lewenthal 1989, Witte 1994). Witte’s (1992, 1994) EPPM is a message design theory that predicts how an individual might respond to relevant health risk messages (i.e., accept or reject a message; adopt or not adopt a recommended behavior) based on their perceptions of threat and efficacy. The primary components of the EPPM (Table 1) include perceived severity (i.e., perceptions about the seriousness of a particular threat), susceptibility (i.e., perceptions about how susceptible you are to that threat), self-efficacy (i.e., perceptions about your ability or inability to perform a recommended behavior), and response-efficacy (i.e., perceptions regarding the effectiveness of a recommended behavior at reducing the threat). According to the EPPM, in order to be motivated to act on a health message, one has to perceive that one is both susceptible to a severe threat and capable of performing a recommended behavior that is effective at averting the threat (Fig. 1). If those 2 conditions are not met, one may either not respond to the message at all (i.e., in cases where both efficacy and threat are perceived as low, or cases when threat is portrayed as low), or one may reject the message outright and respond by controlling one’s fear instead of adopting the recommended risk-reducing behavior (i.e., in cases where threat is perceived as high, but efficacy is perceived as low). Health communication campaigns using fear appeals should develop risk messages with careful consideration of existing threat and efficacy perceptions of their target audience (Cho and Witte 2005).

We draw upon the EPPM to evaluate the severity, susceptibility, and efficacy messages found in agency risk communication materials related to TB management in Michigan and Minnesota. We used the EPPM to: describe the type of risk communication materials available to stakeholders in Michigan and Minnesota; identify and compare the recommended responses promoted in the materials; and characterize and compare threat and efficacy messages found in the materials. The EPPM is a widely used and cited framework among health communication professionals and has been applied in a number of contexts, including but not limited to the following: firearm safety behaviors of students in a hunter safety program (e.g., Roberto et al. 2000), handwashing behaviors of college students (Botta et al. 2008), hearing-protection programs for farmers and landscape workers (Smith et al. 2008), asthma interventions with school workers (Goei et al. 2010), and radon awareness campaigns among African Americans (Witte et al. 1998).
METHOD

This study reports on a content analysis of a sample of risk communication materials (e.g., brochures, handouts, websites) containing agency-based information about TB and available to the public in Michigan and Minnesota during April 2010. Content analysis is a rigorous and systematic procedure for assessing the content of documented information (Riffe et al. 1998, Wimmer and Dominick 2003) and is frequently used to assess and evaluate risk framing and messaging in both conservation (e.g., Siemer et al. 2007, Muter et al. 2009, Houston et al. 2010, Gore et al. 2011) and health communication (e.g., Lapinski 2006) contexts.

We acquired a sample of TB risk communication materials in April 2010 using 2 approaches. First, we made requests to all agencies and organizations in each state that are responsible for managing and communicating about TB. Then, we conducted an online search with Google (Mountainview, CA, USA) for materials using the keywords: “bovine tuberculosis,” “Michigan,” “Minnesota,” “educational materials,” and “brochures.” All active content (e.g., websites) was captured (i.e., turned into a PDF file) and printed during a 24-hour period (McMillan 2000).

Our objectives guided the development of a protocol and codebook containing 87 variables divided among 10 sections. Two trained coders independently reviewed each material to identify 1) severity and susceptibility messages discussing TB-related risks to wildlife, livestock, ecosystems, human health, and the economy; 2) recommended responses; and 3) self- and response-efficacy messages connected to each of the recommended responses (Table 1). Coders also recorded: 1) general descriptive information (e.g., type of material, publication date, distribution information, types of images used); 2) primary target audience; 3) message sources; and 4) basic information about TB (e.g., disease history, ecology) presented in each material.

We computed Cohen’s kappa for each variable across the 41 materials to assess agreement among the 2 coders (Cohen 1960, 1968); we excluded all variables with $k < 0.7$ from analysis (Lombard et al. 2002). Descriptive analyses were run with PASWStatistics 18 software (SPSS Inc., Chicago, IL). We used Kendall’s rank coefficients (tau-b) to assess the relationships between recommended responses and efficacy messages.

RESULTS

Description of Materials
We identified 41 unique risk communication materials. Most of these were handouts ($n = 17$) and brochures ($n = 13$); other materials included websites ($n = 5$), booklets ($n = 4$), and hunting regulation guides ($n = 2$). Only 3
of these materials were not available electronically. Seventeen materials did not list a publication date; the remaining 24 materials were published in 2005 (n = 3), 2006 (n = 1), 2007 (n = 1), 2008 (n = 3), 2009 (n = 7), or 2010 (n = 9).

The U.S. Department of Agriculture (n = 19), Michigan Department of Agriculture (n = 19), Michigan Department of Natural Resources (n = 16), Michigan State University (n = 11), Michigan Department of Community Health (n = 8), Minnesota Board of Animal Health (n = 7), Minnesota Department of Natural Resources (n = 7), and Minnesota Department of Agriculture (n = 3) were the principal sources of TB risk communication materials. Approximately half of the materials (n = 20) listed multiple sources (M = 2.2, SD = 1.7). Most materials were produced specifically for Michigan audiences (n = 27); 11 were produced for Minnesota audiences; and 3 were not specified to a particular geographic audience. We identified livestock producers (n = 21) and hunters (n = 10) as the primary target audiences, followed by the general public (n = 9) and landowners (n = 1).

**Threat Messages**

Seventy-three percent (n = 30) of the TB risk communication materials contained ≥1 severity messages (e.g., “The presence of bovine TB in Michigan’s white-tailed deer is a serious problem. At risk are Michigan’s deer herd and other wildlife species with their many social, ecological, and economic values [. . .]”; M = 5.9 severity messages/material, SD = 8.1); 56% (n = 23) contained ≥1 susceptibility messages (e.g., “The prevalence of bovine TB remains low and is confined to a relatively small geographic area.”; M = 2.8 susceptibility messages/material, SD = 3.8). If severity messages were present, they tended to portray TB-related risks to wildlife, livestock, the economy, and ecosystems as high and risks to human health as low (Table 2). If susceptibility messages were present, they typically conveyed TB-related risks to wildlife, ecosystems, and human health as low and risks to livestock and the economy as high (Table 2).

**Recommended Responses**

Approximately 80% (n = 33) of materials promoted ≥1 recommended behaviors (M = 6.6 recommended responses/material, SD = 8.5). Recommended responses varied across materials and target audiences, but generally fell into 1 of 6 categories: 1) become informed about TB-related risks (e.g., “know the signs of TB–infected wildlife”); 2) contact the authorities if you suspect you have encountered an infected animal (e.g., “submit deer heads to the DNR for testing,” “seek medical attention if exposure has occurred”); 3) take precautions to minimize risk of TB transmission to humans (e.g., “wear gloves while field dressing a deer,” “cook venison thoroughly”); 4) take precautions to minimize wildlife–livestock interactions (e.g., “develop a wildlife risk mitigation plan,” “store livestock feed securely”); 5) take non-wildlife–related precautions to minimize risk of TB transmission to cattle (e.g., “use electronic identification,” “only buy cattle from verified farms”); and 6) take precautions to minimize risk of TB transmission to wildlife (e.g., “do not feed deer or elk,” “participate in antlerless deer hunts”; Table 3).

**Efficacy Messages**

Sixty-six percent of materials (n = 27) contained ≥1 response-efficacy messages (e.g., “While much work remains, substantial progress has been made toward eradication of TB from Michigan wildlife;” M = 0.5 response-efficacy messages/material, SD = 1.4); however, only 24% (n = 10) contained ≥1 self-efficacy messages (e.g., “Livestock producers can take simple steps to prevent their herds from becoming infected with bovine TB;” M = 1.7 self-efficacy messages/material, SD = 1.7; Table 3). Two recommended responses, when present, were regularly coupled with response-efficacy messages (i.e., contacting authorities if you suspect you have encountered an infected animal [tau-b = 0.305, P = 0.045] and taking precautions to minimize wildlife–livestock interactions [tau-b = 0.418, P = 0.002]). Other recommended responses were not associated with response-efficacy messages (Table 4). Interestingly, response-efficacy messages describing the effectiveness of approaches to prevent TB transmission to wildlife were often presented without explicitly defining the recommended behavior (e.g., follow all baiting and feeding regulations, harvest antlerless deer to help reduce deer density; Table 3).

**DISCUSSION**

All message components central to the EPPM (i.e., recommended responses, threat and efficacy messages) were identified in our sample of TB risk communication materials; however, some message elements were more frequent and widespread than others. The majority of reviewed materials promoted ≥1 behaviors believed to reduce the risks of TB transmission among and between wildlife and livestock in Michigan and Minnesota. This finding implicates persuasion as an important objective of existing TB risk communication efforts, in addition to the need to inform and educate stakeholders about TB and its related risks. Given agency desire for key stakeholders (e.g., hunters, livestock producers) to adopt risk-reducing behaviors, the EPPM was a useful framework for describing and comparing materials and messages for disease-related stakeholders. Further, the framework may also help agencies identify areas in need of improvement.
Our results can help inform development of future TB risk communication efforts. To increase the likelihood of motivating desired risk-reducing behaviors among stakeholders, one suggestion for future communication programs would be to enhance existing messages related to efficacy: promoting that the recommended behaviors are both easy to do and effective. The latter part of this statement echoes Dorn and Mertig (2005), who noted that providing evidence that TB eradication efforts are working, or will work (i.e., response-efficacy), could be used to bolster public support for management objectives. According to the EPPM, threat messages that are not coupled with efficacy messages may yield dysfunctional behavioral responses (Witte 1992, 1994).

Another recommendation would be to ensure that TB risk communication materials (and messages) are regularly updated. Of the materials that listed a publication date, approximately 20% were 4 or 5 years old. Updated communications could help thwart message fatigue by reflecting management successes (and enhance perceptions of response-efficacy), identifying new risks and, when possible, recommending new or more effective behaviors stakeholders can adopt to reduce those risks.

Messages conveying severity and susceptibility of TB-related risks were commonplace in our sample. Severity messages, when present, typically were portrayed as high (with the exception of TB risks to human health). These message characteristics mirror results of TB-related surveys conducted and published over the past decade. For example, a 2000 mail survey of resident and non-resident deer hunters, business owners, livestock producers and the general public in northeast Michigan (Dorn and Mertig 2005) revealed that approximately 60% and 43% of respondents believed the presence of TB in northeast Michigan was a serious threat to deer and livestock herds, respectively. Given the congruence between threat messages presented in TB communication materials and the aforementioned stakeholder-informed data (Dorn and Mertig 2005), one may question whether these messages need to be changed—or even if they can be changed without misrepresenting the assessed ecological and economic risks of TB—to increase adoption of desired behaviors.

Susceptibility messages, on the other hand, were usually conveyed as low for wildlife and human health, but high for livestock and the economy. Given the diversity of stakeholders affected by TB management and their different motivations for desiring TB eradication, communication efforts tailored to specific groups or segments of stakeholders may be more effective at promoting behavior change (Jacobson 2009). Identification and description of these specific groups and segments is a logical starting point for future research.

Most materials did not portray high threat messages with high efficacy messages; however, that prescribed messaging combination may not be needed pending the target audience’s existing levels of perceived severity, susceptibility, and efficacy (Cho and Witte 2005). For example, the aforementioned surveys provide some evidence that TB risk communication efforts may not need to emphasize threat messages because perceived severity and susceptibility of TB risks might already be high among some stakeholder groups. To successfully complete evaluation of the effectiveness of TB risk communication campaigns, it is vital to assess the target audiences’ existing levels of perceived threat and efficacy prior to, and following, the communication program. Experimental research is also needed to assess how the messages identified in these materials are actually interpreted by the stakeholders targeted by agency communications.

Some practitioners have cautioned about the use of fear appeals in wildlife management. One important consideration is how fear-appeal-inspired messaging might influence public attitudes toward wildlife species and their management, particularly the unintended consequences of these

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Table 3. Percentage of bovine tuberculosis (TB) risk communication materials from Michigan and Minnesota, USA, during April 2010, that promoted recommended responses and the percentage of materials that contained response-efficacy messages (that highlight effectiveness of recommended responses) and self-efficacy messages (that promote ease and ability of performing those recommended responses).

<table>
<thead>
<tr>
<th>Recommend response</th>
<th>%</th>
<th>Response-efficacy</th>
<th>Self-efficacy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Become informed about TB-related risks</td>
<td>24</td>
<td>0.138</td>
<td>0.521</td>
</tr>
<tr>
<td>Contact authorities if you suspect you have encountered an infected animal</td>
<td>24</td>
<td>0.305</td>
<td>0.667</td>
</tr>
<tr>
<td>Take precautions to minimize risk of TB transmission to humans</td>
<td>24</td>
<td>0.191</td>
<td>0.708</td>
</tr>
<tr>
<td>Take precautions to minimize wildlife–livestock interactions</td>
<td>22</td>
<td>0.418</td>
<td>0.002</td>
</tr>
<tr>
<td>Take non-wildlife-oriented precautions to minimize risk of TB transmission to livestock</td>
<td>7</td>
<td>0.049</td>
<td>0.793</td>
</tr>
<tr>
<td>Take precautions to minimize risk of TB transmission to wildlife</td>
<td>7</td>
<td>0.138</td>
<td>0.521</td>
</tr>
</tbody>
</table>

Table 4. Association (tau-b) of recommended responses with the presence of response- and self-efficacy messages found in bovine tuberculosis (TB) risk communication materials from Michigan and Minnesota, USA, during April 2010.

<table>
<thead>
<tr>
<th>Recommend response</th>
<th>Response-efficacy</th>
<th>Self-efficacy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Become informed about TB-related risks</td>
<td>0.078</td>
<td>0.667</td>
</tr>
<tr>
<td>Contact authorities if you suspect you have encountered an infected animal</td>
<td>0.305</td>
<td>0.045</td>
</tr>
<tr>
<td>Take precautions to minimize risk of TB transmission to humans</td>
<td>0.191</td>
<td>0.254</td>
</tr>
<tr>
<td>Take precautions to minimize wildlife–livestock interactions</td>
<td>0.418</td>
<td>0.002</td>
</tr>
<tr>
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<td>0.138</td>
<td>0.521</td>
</tr>
</tbody>
</table>

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messages. In an early study of messaging effects on back-country visitors to national parks, Hodgson (1974) noted that fear appeals may escalate negative attitudes toward grizzly bears and result in reduced support for conservation efforts to protect bears. Similar concerns have been raised about the role of fear appeals in stigmatizing groups with particular health conditions (Guttman and Salmon 2004). Future inquiry should consider how public attitudes toward deer change in concert with changing TB risk messaging.

Jacobson et al. (2006) warned that fear appeals are only effective at promoting behavior change when they are accompanied by simple and reasonable information about how to avoid, or reduce, the risk. For this reason, it is important not only to ensure the target audience understands the recommended TB risk-reducing behaviors but also that the audience has high perceived efficacy that those behaviors are both easy to do and effective at reducing TB risks. Without adequate prior understanding of those perceptions, use of fear appeals in communication campaigns may not only be ineffective, but they may also promote fatalistic attitudes toward achieving management objectives (e.g., “No matter what I do, TB is going to persist.”) and maladaptive behaviors (e.g., continue baiting and/or feeding deer; Witte 1992, Jacobson et al. 2006). Evaluation of existing communication efforts and careful communication and message planning can help overcome these obstacles.

MANAGEMENT IMPLICATIONS

Given the ubiquity of wildlife disease issues across human-dominated landscapes, it is reasonable to suspect that wildlife-related risk communication programs are going to become an increasingly important intervention for wildlife disease management (Vaske et al. 2009). Regardless of the background and training of the individuals responsible for creating these programs and materials, consideration of message design components is vital to increase the likelihood of achieving desired attitude and behavior changes. Further, evaluation of existing communication programs can help describe the current communication environment, compare existing messages with present management needs, and identify areas in need of improvement.

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LITERATURE CITED


