



# Working with State and Provincial Apiary Programs to Manage Honey Bee (*Apis mellifera*) Health

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## KEYWORDS

• Honey bee • Apiarist • Apiary inspector • Apiary program

## KEY POINTS

- Beekeeping is an important agricultural business that provides pollination services for many crops and wildflowers, honey, hive products, and bees.
- Most states, territories, and provinces have laws and regulations pertaining to honey bee health and beekeeping.
- Apiary inspectors and apiary programs are primarily responsible for enforcing the laws and regulations of certain honey bee pests and diseases. Apiarists also often serve as educators, researchers, state fair superintendents, and coordinators for other-bee related activities, such as Managed Pollinator Protection Plans.
- As a result of the Food and Drug Administration Veterinary Feed Directive (VFD), which went into effect in 2017, beekeepers now are required to obtain a VFD or veterinarian's prescription to purchase antibiotics used to manage American foulbrood or European foulbrood. Apiary inspectors are eager to collaborate with veterinarians in facilitating and fulfilling legal requirements of the VFD (or prescription).
- Communication between apiarists and veterinarians is key to managing healthy honey bee colonies and controlling disease outbreaks when they occur.

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## BACKGROUND

Commercial beekeeping is an important and viable business throughout North America. In the United States, products and services the beekeeping industry provides contribute significantly to the GDP and are estimated to be valued at \$4.74 billion.<sup>1</sup> Over the past several years, there has been an increasing demand for Western honey bees (*Apis mellifera*), for both pollination of crops and honey production. The beekeeping industry is facing many challenges, however, the most significant of which is honey bee health. The management of honey bee health issues and the interstate movement of hives throughout North America is regulated by officials known as apiarists, apiculturists, or apiary inspectors (hereafter referred to collectively as *apiary inspectors*). Most apiary or bee inspection programs (hereafter referred to collectively as *apiary programs*) are affiliated with either government or university programs. The first apiary program and bee laws in North America were established in California in 1877 in response to a highly contagious and deadly bacterial disease, known as American foulbrood (AFB), caused by the etiologic agent *Paenibacillus larvae*, which was responsible for colony deaths and corresponding catastrophic economic losses for beekeepers (Fig. 1).<sup>2</sup> AFB had been identified as a problem prior to 1877, but as the economic viability of beekeeping grew, state lawmakers began to establish enforceable measures to help mitigate its spread. Over the following decades, several other states, provinces, and territories followed California's lead in developing apiary programs.

During the 1960s to 1990s, the economic viability of commercial scale beekeeping and interstate transport of hives in North America increased and backyard or hobby beekeeping saw a surge in interest. There was a corresponding sharp increase in



Fig. 1. AFB, caused by the bacterium *Paenibacillus larvae*.

cases of AFB and another unrelated bacterial disease, European foulbrood (EFB), caused by the bacterium *Melissococcus plutonius*, across North America (Fig. 2). The primary tool used by beekeepers for both AFB and EFB management has been the antibiotic oxytetracycline.<sup>3</sup> Although an effective management tool for EFB, a non-spore-forming bacteria, oxytetracycline does not cure infection with AFB, which is a spore-forming bacteria. Oxytetracycline suppresses AFB symptoms and requires regular, twice-yearly applications. At times, AFB was so widespread that if a beekeeper did not manage the disease, the hive likely would die from infection, and AFB potentially would spread to neighboring hives. This practice was neither sustainable nor good animal husbandry. As a result, the beekeeping industry petitioned local governments to start or revamp apiary programs. Many states, provinces, and territories responded, which led to the modern iteration of most apiary programs throughout North America. Since the late 1980s, detections of AFB have decreased throughout North America as apiary programs implemented AFB mitigation plans in their respective states, provinces, and territories.

In the 2010s, the Food and Drug Administration (FDA) became concerned with medically important antibiotic use in livestock management. In 2015, the FDA amended the Animal Drug Availability Act of 1996 to include revisions to the Veterinary Feed Directive (VFD) section of the regulation.<sup>4</sup> Similar changes were made in 2017 for Canada's Food and Drug Act Amendments.<sup>5</sup> The revisions limited the use of antibiotics in or on animal feed and required the supervision of a licensed veterinarian for the administration of medically important antibiotics to livestock, including honey bees.

As a result of the VFD, beekeepers and veterinarians have relied on apiary inspectors for clarification of the federal directive. Some states or provinces have a single



Fig. 2. EFB, caused by the bacterium *Melissococcus plutonius*.

apiarist or apiary inspector, whereas others have a chief apiary inspector and several regional apiary inspectors forming a collective apiary program. The chief apiary inspector coordinates the apiary program and oversees seasonal, full-time, or part-time positions based on need and funding. For states, provinces, and territories that do not have apiary programs, government or university-affiliated animal or plant health inspectors perform this role, as needed.

Similar to that of a veterinarian, the primary role of an apiary inspector is to ensure the health and well-being of animals, specifically honey bees. Even though apiary inspectors typically do not receive formal veterinary medicine education and are not considered medical professionals, they often are highly trained and skilled individuals who have considerable expertise in the areas of honey bee biology, health, disease diagnosis, treatment, husbandry, apiary maintenance, pollination, and honey production. The credentials needed to become an apiary inspector are extensive, requiring not only an intimate knowledge of not only honey bees but also field training of the methods involved in beekeeping. Inspectors also must be educated in identifying, diagnosing, and treating honey bee health issues. The best apiary inspectors are those that not only possess this level of education and experience but also have a firm understanding of the complexities of a colony and the dynamics of the beekeeping community.

The primary duty and regulatory authority of an apiary inspector are performing routine or investigative health inspections of honey bee hives. These inspections could be for the purposes of routine annual evaluation, interstate or international transport, or investigation of a particular health issue. Regardless of the purpose, honey bee health inspections evaluate every aspect of both the individual colony (queen, brood, workers, drones, bee behavior, food stores, equipment condition, and so forth) and the apiary as a whole (location, setup, management, equipment storage, transport, and so forth). Inspectors may take samples for bacterial, fungal, viral, and arthropod pest diagnosis (Figs. 3 and 4). These samples either are analyzed internally, using local government or university diagnostic laboratories, or externally through submissions to federal or private laboratories (Table 1). The US Department of Agriculture (USDA) Agricultural Research Service (ARS) Bee Research Laboratory provides free honey bee disease and pest diagnostic services and is used by many apiary programs across the United States. Following an inspection, an apiary inspector issues a report providing the results along with any necessary supporting recommendations for treatment, management, or orders required to meet regulations.

If a health issue is detected during the inspection, the apiary inspector instructs and executes the treatment or decommission of the affected colony/colonies, if necessary. Most honey bee health issues can be treated using cultural methods, pesticides, proper feeding, or antibiotics. AFB is an exception to the rule given that it is extremely virulent and spreads readily between colonies. In most states, provinces, and territories, AFB detection in a hive requires depopulation of the hive followed by destruction, which can include burning of all infected material (discussed later) (Figs. 5 and 6). As previously described, many apiary programs were created in response to the spread and deleterious impact AFB had on honey bee colonies throughout North America. Through the efforts of these individual programs, AFB has been broadly suppressed. Although AFB is not commonly found these days, most apiary programs maintain regulatory authority for this disease. In many states, provinces, and territories, AFB is a reportable disease, meaning that beekeepers are required to inform their local apiary program if they have or suspect they have AFB in their operations.<sup>2</sup>

Like many other types of livestock, honey bees often require health certificates and other documentation before queens, colonies, or used equipment can be moved



Fig. 3. Apiary inspector taking samples of adult bees.



Fig. 4. Apiary inspector taking samples of brood.

**Table 1**  
**Honey bee diagnostic laboratory services for bacterial pathogens**

Laboratory Name	Geographic Service Area	Location	Pathogen		Sample		Analysis Type
			American Foulbrood	European Foulbrood	Type	Fee	
USDA ARS Bee Research Laboratory	USA	Beltsville, MD	+	+	Brood	No	Culture
Utah Department of Agriculture and Food	USA	Salt Lake City, UT	+	+	Brood	Yes	PCR assay
North Carolina State University	USA	Raleigh, NC	+	+	Brood	Yes	Culture
National Agricultural Genotyping Center	USA	Fargo, ND	+	+	Brood, Adult bees	Yes	PCR
University of Guelph Animal Health Laboratory	Canada	Guelph, Ontario	+	+	Brood	Yes	Culture
Province of Manitoba Veterinary Diagnostic Services	Canada	Winnipeg, Manitoba	+	+	Brood, Adult bees	Yes	Culture, PCR
Grande Prairie Regional College National Bee Diagnostic Centre	Canada	Beaverlodge, Alberta	+	+	Brood, Adult bees	Yes	Culture, PCR
Clemson University	USA	Pendleton, South Carolina	+	+	Brood, Adult bees	Yes	PCR assay

*Abbreviation:* PCR, polymerase chain reaction. +, meaning lab offers this type of pathogen analysis.



Fig. 5. Destruction of AFB, *Paenibacillus larvae*-infected nucleus hive.



Fig. 6. Destruction of AFB, *Paenibacillus larvae*-infected hive.

between states, provinces, territories, and internationally. Inspectors issue health certificates and permits for interstate movement or international shipment, when requested by a beekeeper. These types of inspections often contain thousands of individual honey bee colonies, so health certificates often are issued based on an inspection of 5% to 20% of the total shipment.

In 1922, the federal Honey Bee Importation Act went into place that restricted the entry of some populations of honey bees into the United States from other countries.<sup>6,7</sup> At present, most states, territories, and provinces have laws and regulations relating to honey bees and beekeeping.<sup>2,8</sup> In general, the focus on these laws and regulations are specific to the occurrence, spread, mitigation, or treatment of honey bee diseases (AFB, EFB, and so forth) and associated invasive parasites or pests. Diseases, pests, and invasive organisms often are regulated in these laws and contain specific language regarding inspections, disease incidence, notification, treatment, and quarantine. Besides pest and disease language, many apiary laws also contain rules about interstate movement, entry of honey bee colonies, issuance of permits, or health certificates as well as state registration requirements and restrictions regarding the location of apiaries.

In addition to the regulatory component of these positions and programs, apiary inspectors also take on duties and perform services related to providing education, conducting or assisting with research projects, collaborating interdepartmentally to market the beekeeping industry, and providing laboratory diagnostic services of disease samples. Apiary programs tend to be multifaceted and dynamic, adapting to meet the needs of beekeepers under a framework of regulatory stewardship and a passion for healthy honey bees. Despite the need, these programs often are underfunded and understaffed, with many states, provinces, and territories possessing only a single individual or part-time apiary inspector. This limitation, combined with the increased interest in beekeeping, has stretched the capabilities and services of many apiary programs, potentially allowing for undetected incidences of infectious disease.

Apiary inspectors welcome a collaborative relationship with veterinarians who are interested in performing duties that support honey bee health and beekeepers through disease detection, diagnosis, and treatment. Given the regulatory authority of apiary inspectors and expertise of veterinarians, it is important to first establish a relationship and build a communication pathway. Veterinarians should familiarize themselves with the specific language of the laws and regulations for each state, province, and territory in which they work as well as those in surrounding jurisdictions. The best resource to find links to the laws, regulations, and local inspector is on the Apiary Inspectors of America<sup>9</sup> and Canadian Association of Professional Apiculturists<sup>10</sup> Web sites. Once this relationship has been established, the veterinarian should maintain open communication with the apiary inspector to notify the discovery of any regulated disease or pests, such as AFB or EFB, or invasive concerns, such as the Asian giant hornet (*Vespa mandarinia*) or the *Tropilaelaps* mites species.

## DISCUSSION

Since the nineteenth century, commercial and migratory beekeepers largely have been marginalized by regulations from federal regulatory agencies, including the FDA and the Environmental Protection Agency (EPA). Since the 1950s, the commercial beekeeping industry has evolved hand-in-hand with industrial agriculture. As farms became larger, they required more honey bees for fruit and vegetable production, increasing the price paid per hive for pollination rentals. Beekeepers became accustomed to using antibiotics to suppress visible outbreaks of AFB, especially in the

middle of pollination season. The list of crops that require pollination is long (at least 150 crops in North America), but the almond industry is considered the most critical because the seed-set required for a successful crop cannot happen with any other pollinator but honey bees.<sup>11,12</sup> Commercial beekeepers also use antibiotics to suppress visible AFB and EFB symptoms in the small nucleus colonies (commonly called “nucs”) that are produced for sale to consumers.

These different and widespread uses of antibiotics led to their overuse. The first medications used by beekeepers were the sulfa drugs, namely sulfathiazole in the early 1950s.<sup>13</sup> Oxytetracycline (Terramycin), a broad-spectrum tetracycline, became available to beekeepers later in the 1950s, but due to its popularity beekeepers are starting to see resistance to this treatment. The antibiotic lincomycin (Lincomix) was introduced in the 1990s. Finally, in 2005, tylosin tartrate (Tylan) was approved for the control of AFB, but because beekeepers have to remove honey supers for a period of time with the use of this antibiotic, they prefer to use another method of control. Resistance to 1 or more of these antibiotics, such as Lincomix, has been shown in several AFB and EFB populations. Currently in Canada and the United States, there are only a few registered medications and pesticides available for use in honey bee hives.<sup>14,15</sup>

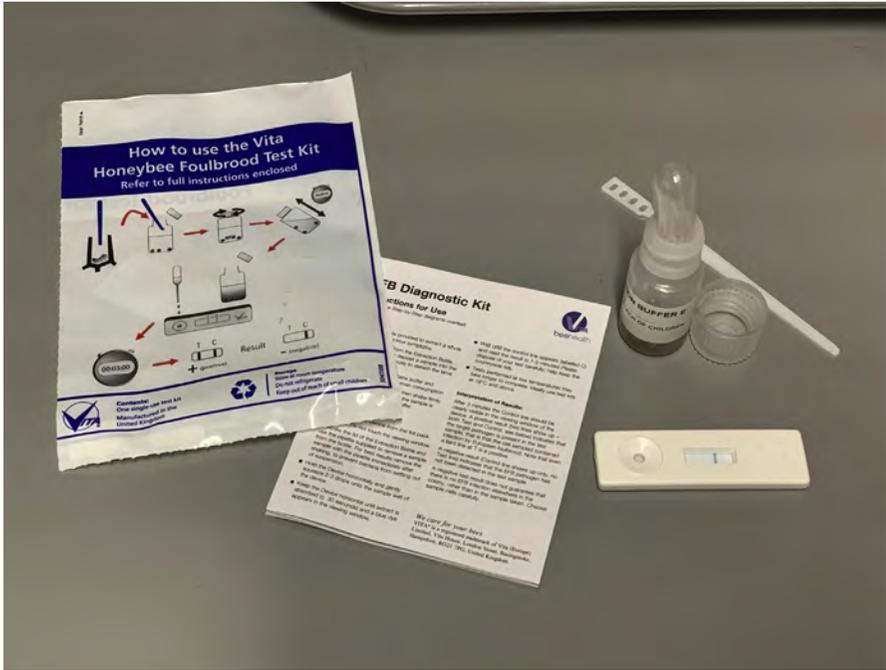
There has been some recent research at Brigham Young University focused on phages, which act as a virus to the AFB bacteria, but that research currently is ongoing and has yet to receive EPA approval.<sup>16</sup> Veterinarians are encouraged to read about this research so that they can stay current on the latest efforts for nonantibiotic control of AFB.

There are some practical tips for veterinarians as they learn more about beekeeping. There are AFB and EFB lateral flow quick diagnostic kits currently on the market that cost approximately \$15.00 per kit ([Fig. 7](#)). These kits must be stored properly and, before use, expiration dates of the test kit should be checked. If a veterinarian notices clinical signs suggestive of AFB, such as a positive rope test or bad odor, the diagnostic quick kit can give a presumptive diagnosis in the field. False-negative results and false-positive results are possible, so all diagnoses should be laboratory confirmed. Veterinarians should consider carrying inventory of these test kits not only for use during clinical examinations but also as a source for beekeepers because access to local beekeeping vendors often is limited. This is a valuable service that veterinarians can provide.

If a veterinarian is called to do an inspection of an AFB hive, they should take a diagnostic kit, disposable gloves, a small flashlight, a shovel, and a can of lighter fluid. If a veterinarian wants to take a sample, with the permission of the beekeeper, they can collect a frame or a subsection of comb from the brood area and send the sample to 1 of the laboratories included in [Table 1](#). If the colony is suspected to have or confirmed to have AFB, the veterinarian should notify the apiary inspector if the state has an apiary program.

Because antibiotics are not effective against AFB, the veterinarian and apiary inspector must work together in destroying the infected materials. For example, here are some basic directions on how to burn a positively identified AFB case. If possible, wait until the end of the day when all forager bees have returned before these steps are taken:

- Check all the other hives in the apiary for signs of AFB. Use a different hive tool from the one used to check the AFB-identified hive and change disposable gloves after every colony inspection.
- Ideally during the day, pour a 5-gallon bucket of soapy water into the hive from the top. This kills the bees while still allowing time for the equipment to dry out before burning.



**Fig. 7.** Diagnostic field kit for testing suspect brood presenting symptoms for AFB, *Paenibacillus larvae*, or EFB, *Melissococcus plutonius*.

- Dig a pit or set up a burn barrel. If necessary, consult the local fire department and notify them of the intention to burn a diseased hive and double-check if any burn bans are in place.
- Start a fire with the diseased frames in the pit or burn barrel first, saving the boxes for last. Make sure that the fire does not get out of control before adding more bee equipment (supers, lid, inner cover, and base). Always have a fire extinguisher and several 5-gallon buckets of water on hand.
- Once the hive has been burned, cover the pit or put out the fire in the barrel.
- If a burn ban is in place and burning is not allowed, put all materials into black plastic bags, seal, and then transport to local landfill for disposal.

If a hive has EFB, most states, provinces, and territories do not require burning. If the EFB disease has spread to other hives, the veterinarian may need to issue a VFD to the beekeeper.<sup>17</sup>

As veterinarians become more familiar with the beekeeping community and honey bee biology, they can assist with hive health by offering additional diagnostic services, such as *Varroa* mite sampling and *Nosema* detection. Veterinarians also may find a place for their leadership if their state has a Managed Pollinator Protection Plan (MP3). Prior to the 2017 VFD enacted by the FDA, the EPA advised states to develop an MP3 to be tailored to each state's unique geography and beekeeping priorities.<sup>18</sup> These plans often prioritize hive health by encouraging farmers and landowners (including homeowners) to reduce chemical use or, if necessary, to communicate with beekeepers prior to application. But there are other components to the MP3 as well, depending on the state in question. Many MP3s have best management practices defined by a state's division of environmental services offices. Veterinarians

should reach out to the apiary program and/or the state department of agriculture to obtain the most recent copy of the state MP3, keeping in mind that states see these plans as evolving and not static documents. No 2 MP3s are the same. Some states do not have a plan at all. Other states want to include all pollinators, not just managed pollinators, such as honey bees. In other words, there are multiple ways that veterinarians can be involved in a state's pollinator issues, not just from a medical standpoint.

Multiple actions can help improve proficiency in honey bee veterinary medicine. Establish a relationship with the state or provincial apiary inspector and arrange a time and place to meet at a beehive. Subscribe to the trade journals *American Bee Journal* or *Bee Culture* or both for a year. Join a local bee association and make an introduction as a veterinarian willing to be available in case there is a problem with a bee hive. Spend a year learning what is a "normal" brood, learn the flowers in the area, learn about winter clusters, and, importantly, learn what is abnormal for a honey bee colony and its inhabitants. Veterinarians often have to adapt to animals for which veterinary school did not prepare them. At the time of this writing, honey bees are one of these species of animals; they are fascinating in terms of sheer ingenuity. Aristotle once said that "beekeeping is farming for intellectuals," so veterinarians already are well-qualified to engage in this journey, hand-in-hand with apiary inspectors.

## SUMMARY

Prior to the 2017 VFD, there were strict divisions between veterinarians and apiary inspectors. Now there is an opportunity for veterinary medicine and apiculture to intersect at a critical time when professional expertise will help ease the transition. The migratory beekeeping and honey production industry are more important, and arguably more reliant on antibiotics, than ever. The more informed and collaborative veterinarians and apiary inspectors are as professionals, the better able they will be to maintain healthy, viable honey bee hives for a thriving sustainable agricultural economy.

## CLINICS CARE POINTS

- Become familiar with honey bee biology, field diagnosis, and disease management techniques.
- Communicate with an apiary inspector and become familiar with the laws, rules, and regulations for the municipalities in the local area.
- Cases of AFB require detection, clinical diagnosis, and laboratory confirmation.
- Contact a local apiary inspector when AFB is suspected and work together to manage the situation.

## DISCLOSURE

The authors have nothing to disclose.

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