



World Organisation
for Animal Health

Best practices and guidelines for responsible antimicrobial use in beekeeping

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Sector FAO Reference Centre for Apiculture, Health and Biosecurity ·
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What the sector has already lost elsewhere

1.14 M

deaths worldwide directly attributable to bacterial AMR in 2021, and 4.71 million associated with it

~40%

of *Paenibacillus larvae* isolates in Argentina are resistant to oxytetracycline
— 16% in North America, after decades of routine use

0

oxytetracycline-resistant *P. larvae* strains found in Uruguay or Chile, where the product is not authorised for honey bees

20%

fall in antimicrobial use in animals in Africa between 2020 and 2022, against 5% globally

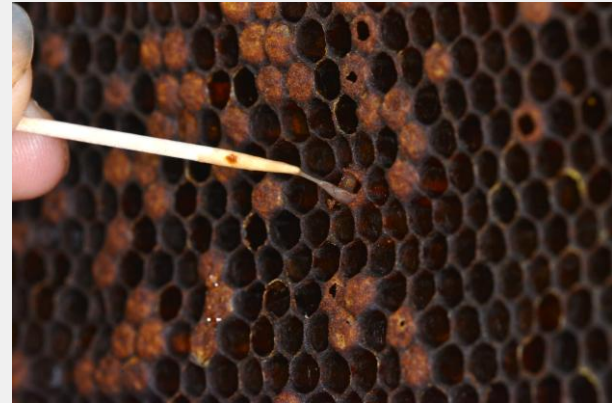
- Resistance in *P. larvae* followed authorisation and routine use, country by country.
- Apiculture is largely absent from national antimicrobial-use reporting

Where the product was never authorised, the resistance was never selected.



Three targets, two product classes

TARGET	PRODUCT CLASS	TYPICAL ACTIVE SUBSTANCES	AMR / RESIDUE RELEVANCE
American foulbrood — <i>Paenibacillus larvae</i>	Antibiotics	oxytetracycline, tylosin, lincomycin, sulfonamides	Direct AMR driver. Resistant strains already reported; residues in honey and wax
European foulbrood — <i>Melissococcus plutonius</i>	Antibiotics	oxytetracycline	Same drivers, and usually avoidable: most cases resolve with management alone
Nosemosis — <i>Nosema (Vairimorpha) apis</i> and <i>N. ceranae</i>	Antifungal	fumagillin	Not authorised in the EU, unavailable in many markets; residues in honey; efficacy contested





Why beekeeping is not like other livestock

The colony is the patient

You are treating thirty to sixty thousand individuals as a single unit. Individual dosing is impossible, and “treat the whole apiary” is the default temptation.

The pharmacy is inside the food store

Brood combs, honey supers and wax sit in the same box. There is no separation between where you medicate and where the food is stored.

The comb is a long-term reservoir

P. larvae spores stay infective in combs and equipment for decades, and wax is rendered and recycled into new foundation — reaching colonies that were never treated.

Bees mix everything up

Foraging over 3 km, plus drifting, robbing and shared equipment, move pathogens, residues AND resistance genes between hives, apiaries and the landscape.

No authorised products, no MRLs

In most countries nothing is registered for honey bees and no maximum residue limits exist. Any residue found is a non-compliance, not a “within-limit” result.

Diagnosis is slow, laboratories are few

So empirical treatment becomes the path of least resistance — treating a guess, at the colony's expense and the product's.



The hive is a crossroads

A colony samples the whole landscape

Foragers cover 3 km and more around the apiary and visit water, soil, nectar and pollen every day. Whatever is inside that circle reaches the hive.



What leaves

Treated bees carry residues and resistance genes back out — onto flowers, water points and neighbouring apiaries, across the whole foraging range.

What arrives

Residues and resistance genes from livestock units, from manure and slurry spread on land, from irrigation and surface water, and from treated crops.

The hive receives the environment's resistance and returns its own.



From the farm next door to the hive: AMR that no beekeeper introduced

1

A nearby unit — poultry, pigs, cattle — treats a batch. Tetracyclines are poorly absorbed: 30–90% of an oral dose is excreted as active metabolite.

2

Manure and slurry are stored, then spread on land. Residues and resistance genes move into soil, run-off, irrigation channels and open water.

3

Plants take the metabolites up from the soil — residues have been measured in lettuce, carrots, tomatoes and maize. Flowers in that landscape are exposed too.

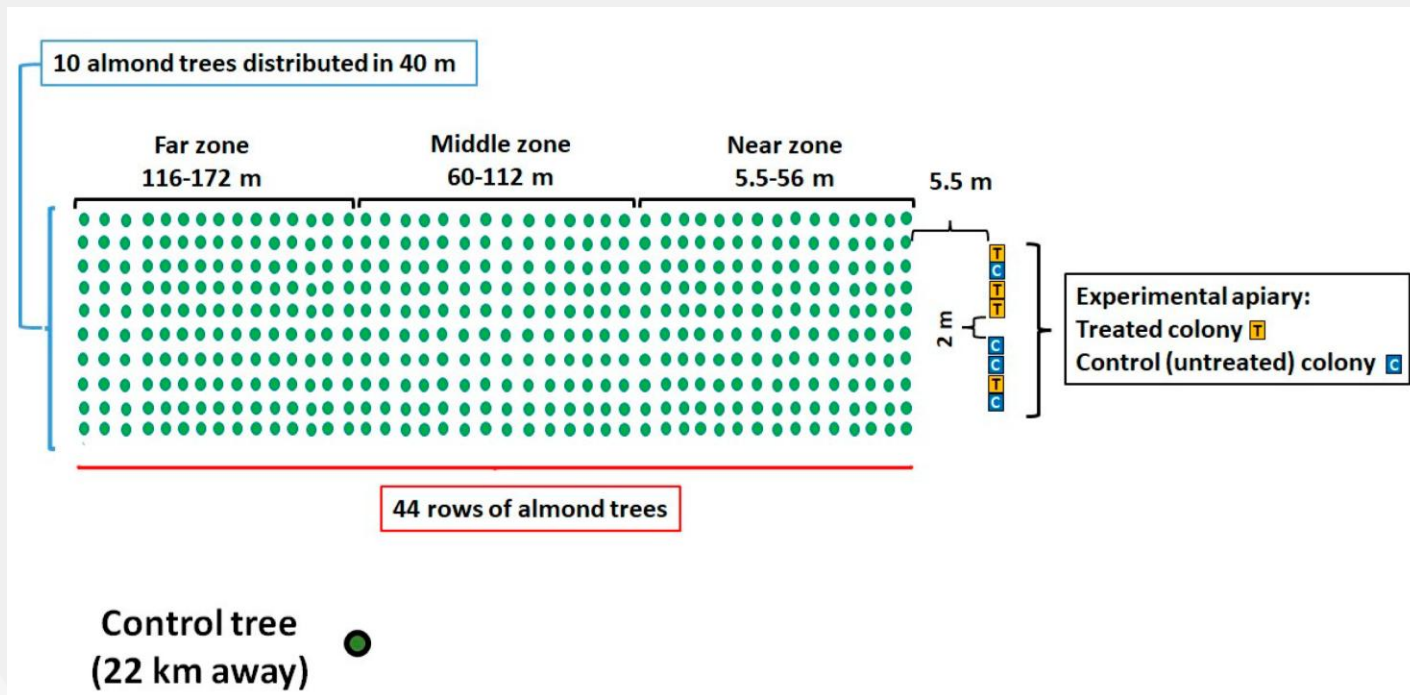
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Bees drink at those water points and forage on those plants, carrying both residues and resistant bacteria back into the colony.

— Reported tetracycline concentrations in the environment: soil 25,000 ppb · wastewater plants 920 ppb · pig waste lagoons 700 ppb · hospital effluent 530 ppb · irrigation water 140 ppb



One apiary, eight colonies





One apiary, eight colonies



20.5 → 135.8

µg/kg of oxytetracycline in the honey of the untreated control colonies, day 3 to day 9. Worst case 432 µg/kg, in the untreated hive standing between two treated ones.

1.0 µg/kg

of oxytetracycline measured in almond flowers after treatment — the first demonstration that treated bees carry an antibiotic out into the environment.

3 days

after treatment, tetracycline-resistance genes appeared in the gut bacteria of colonies in both groups — treated and untreated alike.



The hierarchy of intervention

5. Antibiotics Last resort. Individual hives only, on veterinary prescription, where legally permitted.

4. Low-impact medicines Organic-compatible products — only where one exists, is authorised, and is applied at the right moment.

3. Beekeeping techniques Shook swarm, brood interruption, requeening, comb renewal, equipment disinfection.

2. Biosecurity measures (BMBs) Disease-specific and context-specific: stop introduction, stop spread between hives.

1. Good beekeeping practices (GBPs) Universal, preventive, the foundation. 140 validated practices.

“Antimicrobials should not replace GBPs or BMBs.” FAO & IZSLT (2021), Chapter 3.1



Good Beekeeping Practices (GBPs)

140

validated practices, ranked

251

candidates scored to get there

GBP HEADING	PRACTICES
General apiary management	63
Record-keeping	25
Disease management (general)	23
Veterinary medicines	8
Hygiene · Feeding and watering · Training	7 each



Good Beekeeping Practices are the integrative activities that beekeepers apply for on-apiary production to attain optimal health for humans, honey bees, and the environment



Biosecurity measures (BMBs)

EXTERNAL

- Quarantine new colonies
- Control queen and wax origin
- No second-hand equipment
- Site the apiary for land use
- Give clean water

INTERNAL

- Disinfect the hive tool
- Do not move combs blindly
- Healthy colonies first
- Control robbing
- Keep colony records



Biosecurity measures in beekeeping (BMBs) are operational activities implemented by beekeepers, advisors, and other stakeholders to control and reduce the risk of introducing and spreading specific honey bee disease agents



The technical pivot: pre-clinical indicators

A pre-clinical indicator is a field or laboratory parameter that detects a disease BEFORE clinical signs appear — before the colony weakens, before production falls, and before a medicine looks necessary.

THE ONES THAT MATTER HERE

- *P. larvae* spore load — in honey or in hive debris, by culture or PCR: it finds American foulbrood long before a single ropy scale appears
- Nosema spore counts — microscopy on a pooled sample of about 60 adult bees, reported as spores per bee
- Recorded brood inspection



WHY THEY CHANGE EVERYTHING

- All of them give a NUMBER, not a yes or no. A number is what a threshold can be built on
- They replace “treat because it is the season” with “treat because the count exceeds the threshold”
- They let you verify that an intervention worked — count before, count after — instead of assuming it
- They detect the subclinical carriage that clinical inspection can never see
- They generate the data a national AMU and AMR programme needs in order to exist at all

THE PROGRESSIVE MANAGEMENT PATHWAY

Scaling it up

From a single apiary to a national programme



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The Progressive Management Pathway

Stage 1

Risk assessment

Stakeholders assess current practice, the risks, and how far biosecurity is already applied, through field surveys. Annex 3 provides ready-made questionnaires on infectious disease management and on AMR.

Stage 2

Local / provincial biosecurity

A Biosecurity Management Plan combining GBPs and BMBs, validated and approved by local beekeepers, applied in daily apiary management.

Stage 3

National biosecurity

The effort expands into a National Biosecurity Management Plan, made accessible to every beekeeper in the country.

Stage 4

Sustainable national biosecurity

A Sustainable National Biosecurity Management Plan: reduce antimicrobial use and control disease through management, technique and low-impact products.

Prerequisite: local authorities, beekeepers and experts working together, with government support. Outcome: the competence to maintain national sustainable beekeeping — which builds international confidence and eases trade.



The pathway for AMR

Awareness

Goal: improve understanding of GBPs, BMBs, AMU and AMR. Stage 1 gather data and survey awareness · 2 local training and review of veterinary curricula · 3 national campaign, curricula revised · 4 training on alternatives, re-survey, re-launch.

Governance

Goal: strengthen governance of antimicrobial use and resistance in food and agriculture — legislation, registration and control of veterinary products, prescription requirements, and enforcement reaching the point of sale.

Evidence

Goal: build capacity for monitoring and surveillance. Verify which antimicrobials are in use · determine the routes by which they arrive, including from outside the apiary · assess laboratory capacity for diagnosis and residue detection · build monitoring plans.

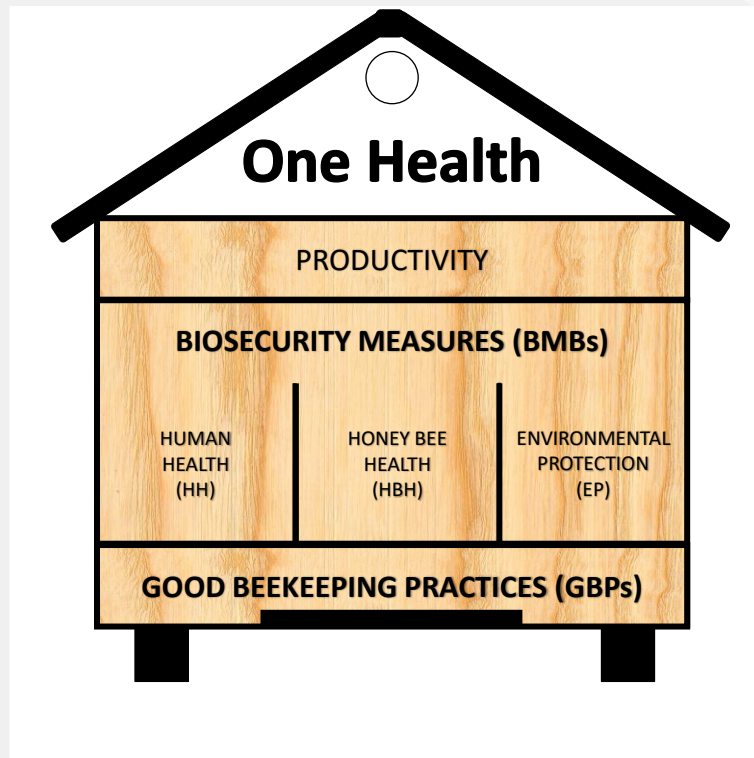
Practices

Goal: promote good practices and the prudent use of antimicrobials — GBPs, BMBs, integrated control, alternatives to high-impact products, and training of beekeepers and veterinarians.



Take-home messages

- 1 Prevention is a published, ranked list — not a slogan
- 2 The pivot is diagnosis: one number changes the decision
- 3 Antibiotics do not cure foulbrood
- 4 AMR also arrives from outside the apiary
- 5 Prevention now is cheaper than reduction later





Resources

- FAO Guidelines (Available online)
- WOAH Terrestrial Code and Manual
- ANIMUSE — amu.woah.org



Thank you

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