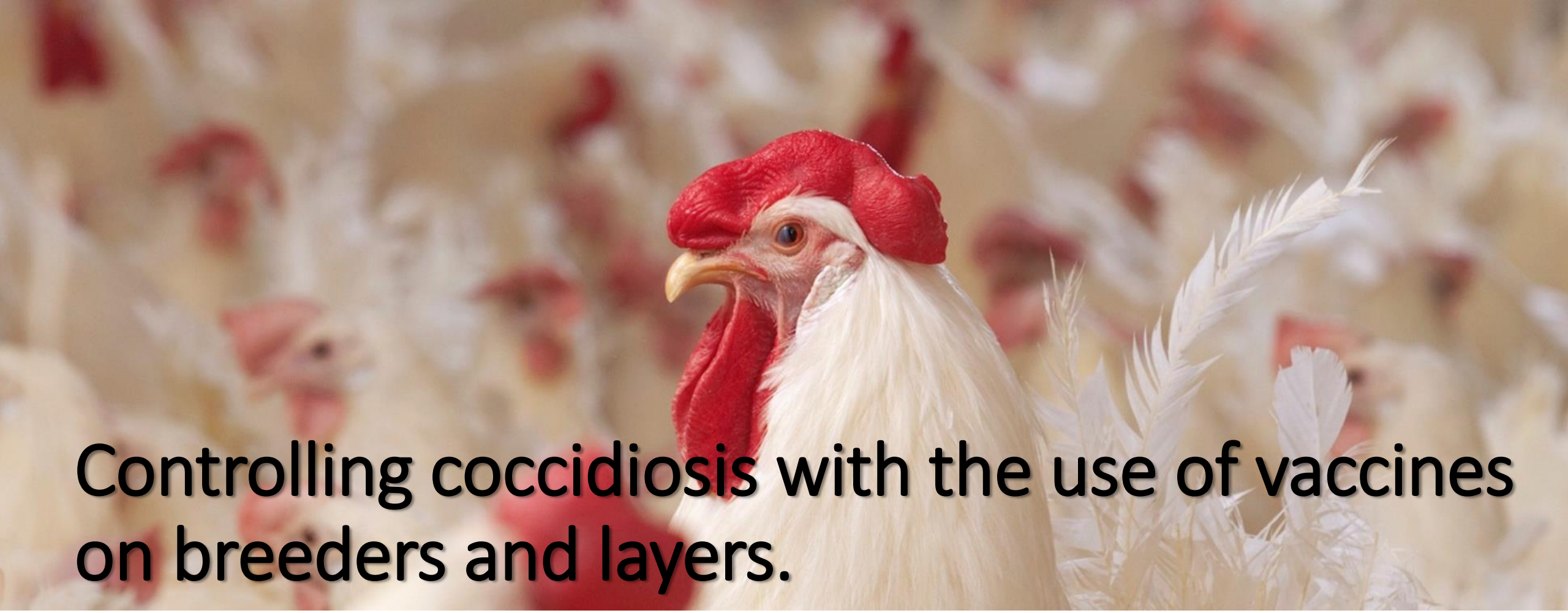

Controlling coccidiosis with the use of vaccines on breeders and layers.

Felipe A. Silva

2023 Poultry Innovation Partnership – Innovation Showcase webinar

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What is coccidiosis?

The Big Three

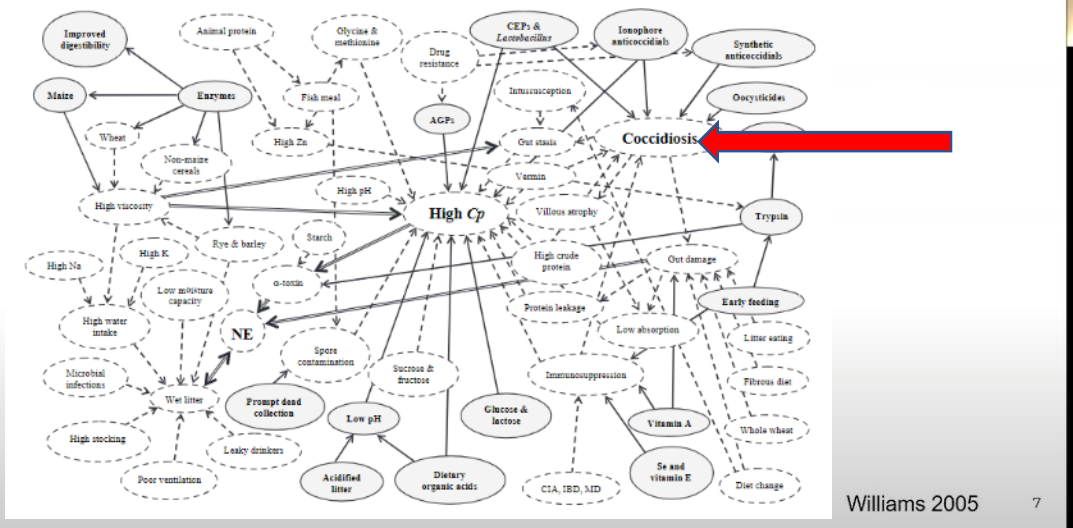
Our Own Big Three:

- Coccidiosis
- Bad Bacteria
- Diseases

That's the focus in the context of AI and Data.

Source: **Poultry Innovation Partnership / Art Van Zanten**.

Necrotic Enteritis – Complex disease



Source: **Poultry Innovation Partnership / Greg Page, citing Williams, 2005.**

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Real Feeding Values

- Real time accurate nutrition
- Wide use of Near Infrared Technology (NIR)
- The determination of the actual feeding values represents a relevant advantage, beyond the reference values.

Gut Integrity

Healthy gut = Maximal Absorption of Nutrients

- Nutrient balance
- Microbial stability
- Ecological environment

Feed and Water Quality + Biosecurity

- Feed grain and protein production, storage, processing and feed manufacture.
- Control of micotoxins.
- Water availability, effective chlorination and acidification.

Early/In-Ovo feeding + programming genes

- Positive benefits of administration of digestible nutrients to embryos.
- Conditioning of gene expression, imprinting of genes post-hatch.

Coccidiosis Control

- Key concern in poultry farm (including subclinical coccidiosis)
- Natural control compounds are being introduced in the feed.

Source: **Adapted from Rigolin, 2013. The future of poultry nutrition 1:1 feed conversion by 2025**

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Coccidiosis overview - Introduction

Source: Animal Parasitology (k-state.edu)

- Coccidiosis is caused by various *Eimeria species (intracellular parasitic protozoa)* affecting mostly the digestive tract of poultry (Manual of Poultry Diseases, 2015).

- Coccidiosis is a self-limiting disease (immunity development) and can be seen as clinical or subclinical (Convey and Mackensie. Poultry Coccidiosis, 2007).

- Economical global impact is estimated over US$2.4Billion, including clinical, subclinical coccidiosis (76%) and drug related cost (24%)(Zhang et al. 2013).

- *"Coccidiosis is not just a disease of a bird of a flock, it is a dynamic, fluid population within the barn"*

Source: Conway and McKensie, 2007

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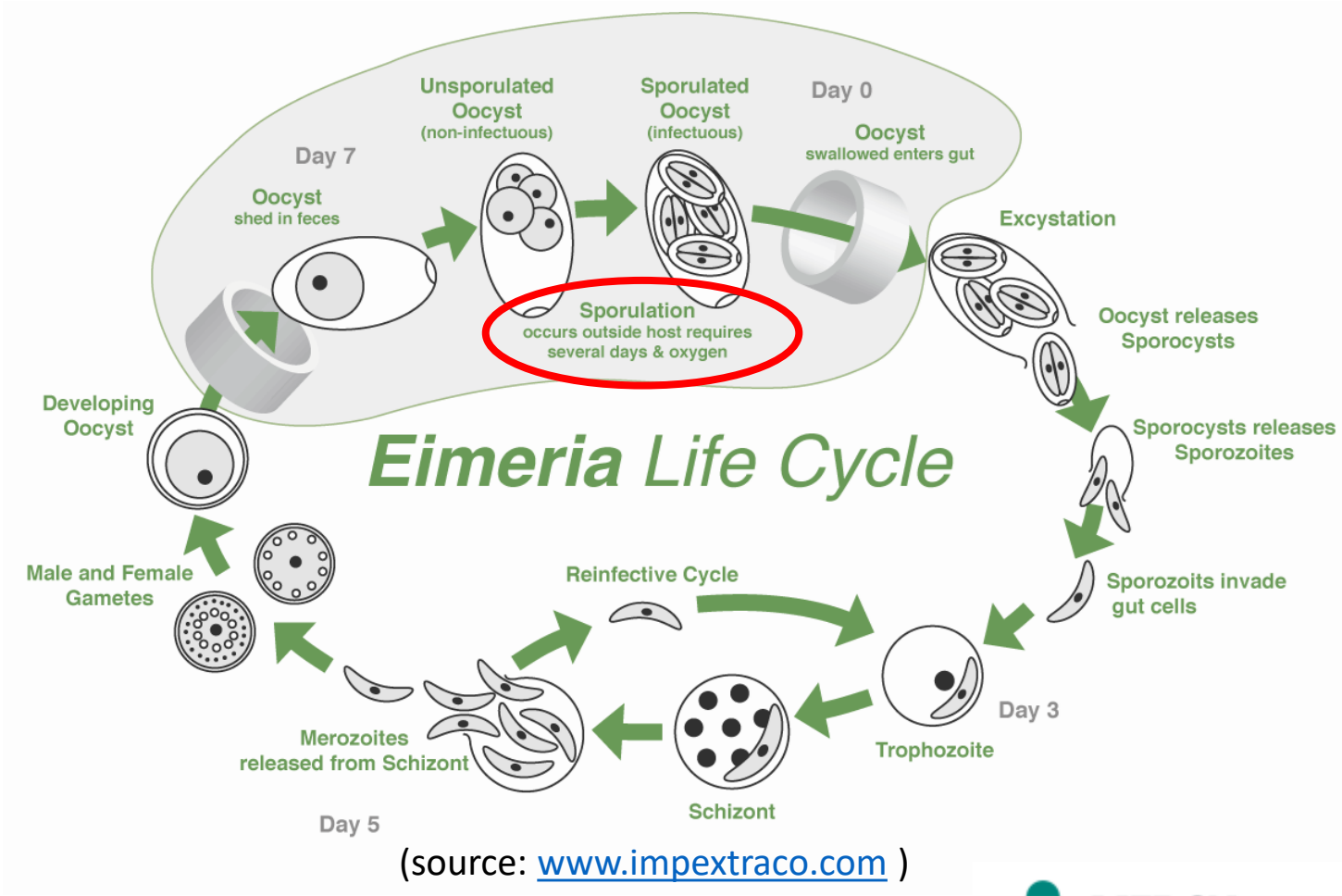
Coccidiosis overview - cycle

- *Eimeria* life cycle takes place **both inside and outside of the bird.**
- Inside the host this cycle will cause different levels of intestinal damage.
- The goal is to reduce that damage either by using anticoccidials or proper vaccination.
- Sporulation (infectious form) happens outside the host and requires humidity, temperature and oxygen (either field infection or vaccine source).



(source: www.impextraco.com)

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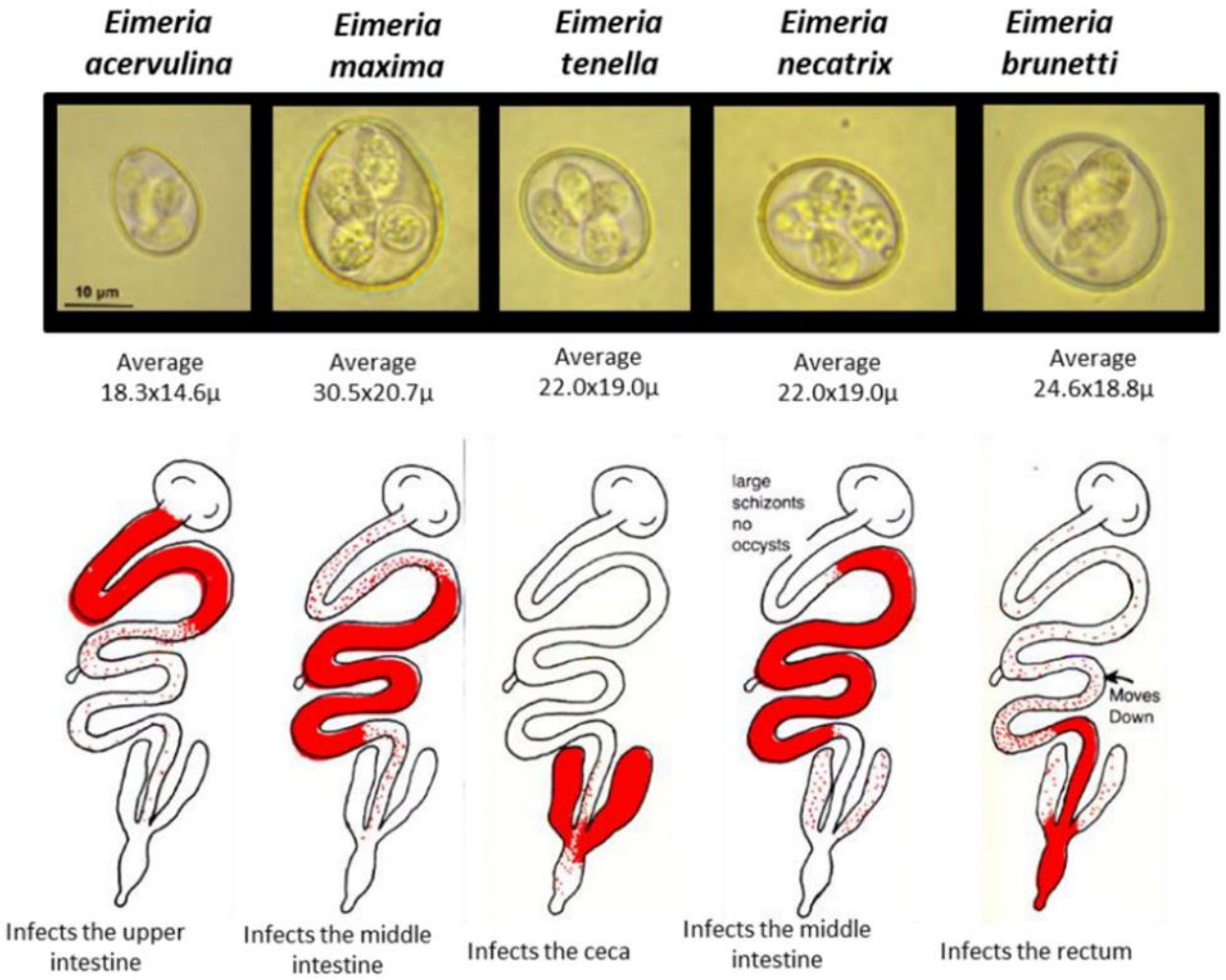
Coccidiosis overview – *Eimeria* types



- Coccidiosis lesions can be observed in various part of the intestine, from the duodenum to the rectum.
- Different *Eimeria* species develop in different parts of the intestine.
- Lesions can be scored through diagnostic necropsy.
- Oocyst per gram of droppings (OPG) is a tool to measure levels of infection.

Source: Adapted from Reid, W.M. and P. L. Long. 1979

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Coccidiosis overview – *Findings*

Source: F. Silva

Sources: Manual of Poultry diseases. 2015 // Bayer Manual of Coccidiosis.

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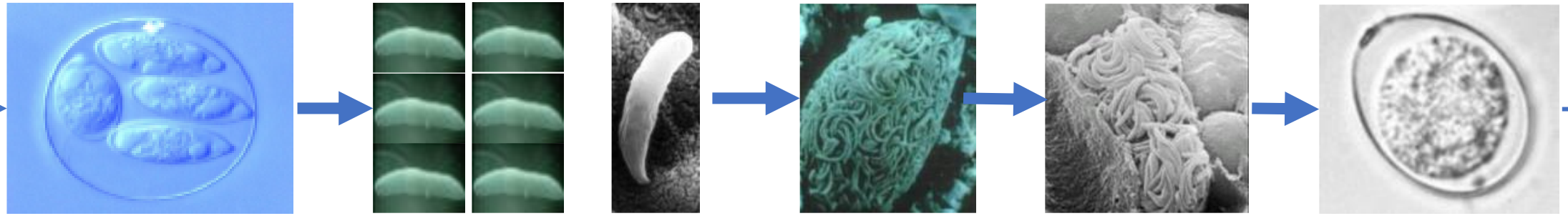
Coccidiosis overview (life cycle and damage)



Sporulated oocyst including 4 sporocyst

Sporozoite

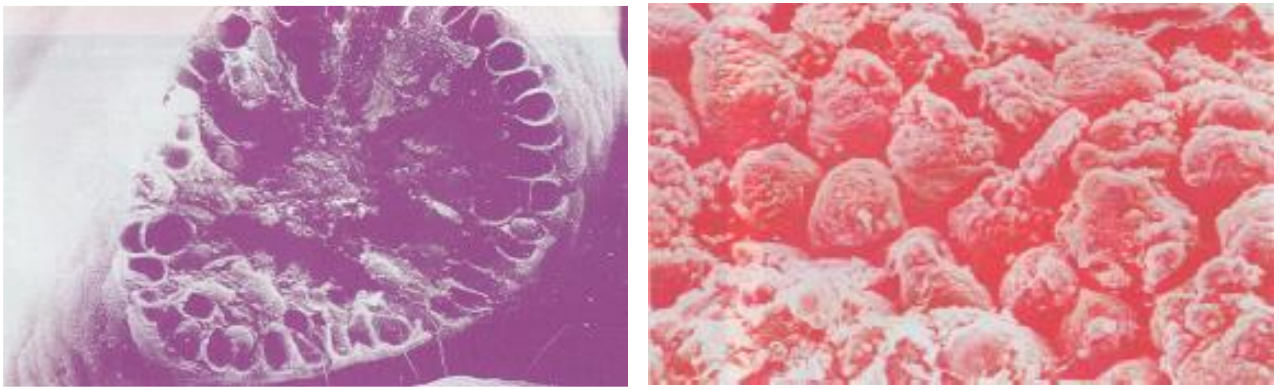
Schizont 1-2

Microgamete

Un-sporulated oocyst

Healthy intestinal surface (enterocytes)

VS.



Intestinal damage

Source: **Adapted from** Soares, 2011 Aviagen.

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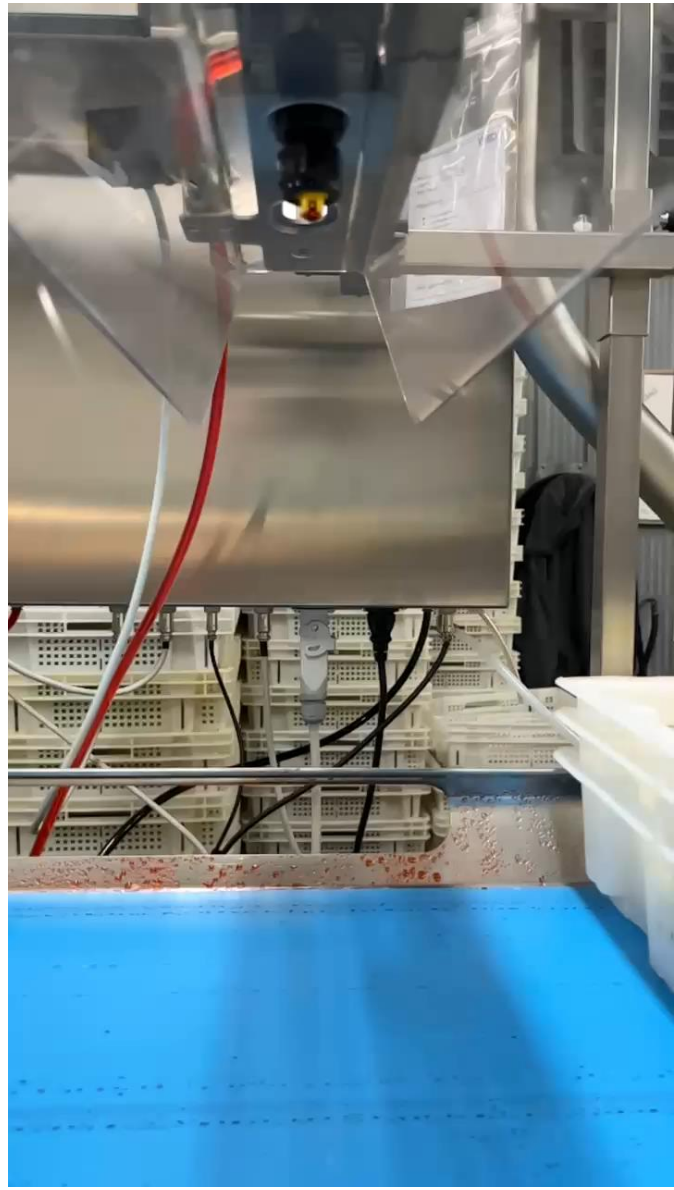
Coccidiosis vaccination & control

- Drug resistance in Eimeria is common because of long term use of anticoccidial drugs for the control of avian coccidiosis. However, anticoccidials remain as a valuable practice when done properly, which includes rotation, combination and/or the use of alternatives like vaccination, or botanical products (Abbas et al. 2011; Kadykalo et al. 2018).

- With the introduction of coccidiosis vaccines on the early 90's, the strategy for coccidiosis control in breeders changed dramatically (Bruzual and Marton, Aviagen 2022).

- Vaccination is used for coccidiosis control alone or as part of a farm program that include medication (restore drug sensitivity) or the use of plant products (Chapman and Tathinam, 2022).



Source: Stephen Bell, 2022

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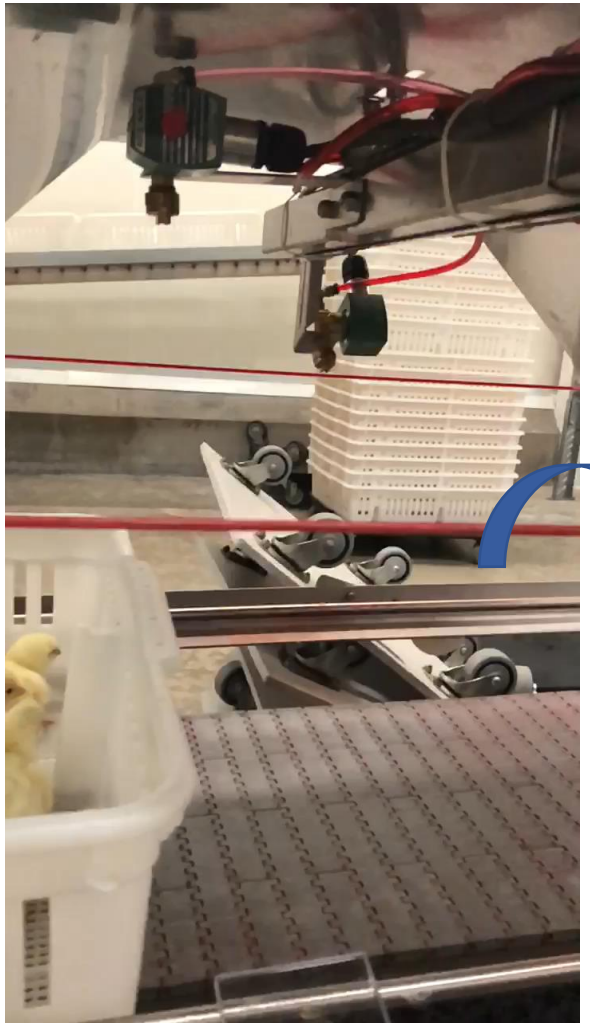
Coccidiosis vaccination - Hatchery

- Vaccine application is usually done at the hatchery and should be validated frequently. However, immunity development requires additional management practices at the farm during the first 7-21 days to achieve proper field conditions (litter/rearing paper moisture, oxygen and temperature). (Mouw and Wilson, WPDC, 2021).

Coccidiosis vaccination - goals

Development of complete immunity	• Low level exposure • Early exposure
Intestinal Health	• Reduced risk of NE • Reduced risk of Osteomyelitis, etc.
Pullet Uniformity	• Lower CV • Reduced competition
+Fertile/Hatchable eggs	• Profitable flocks



Source: Recording Spraycox X by Leo Buduan + Felipe Silva, 2023

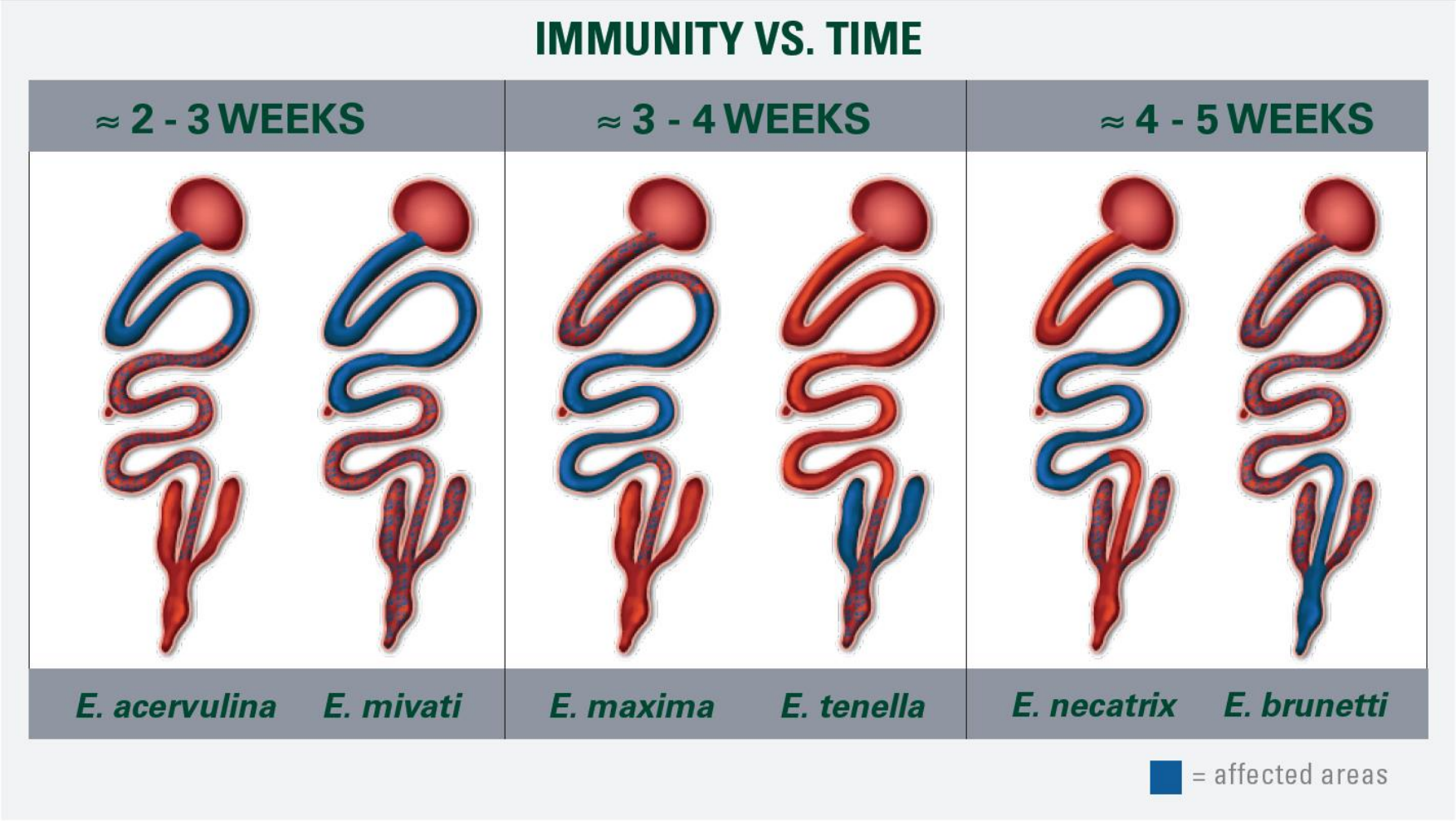
Coccidiosis vaccination – Farm practices

- Farm practices are intended to achieve certain humidity levels in the litter/rearing paper during oocyst shedding especially close to day 7 (day 14 and 21) after vaccination.
- Goal is sporulation (“activation”) of shed Oocyst in the litter/ rearing paper, so birds eat them and “revaccinate” themselves. This process should take place several times to develop immunity.

Left: Partial brooding on a broiler farm / Right: Proper litter moisture and barn conditions at day 7)

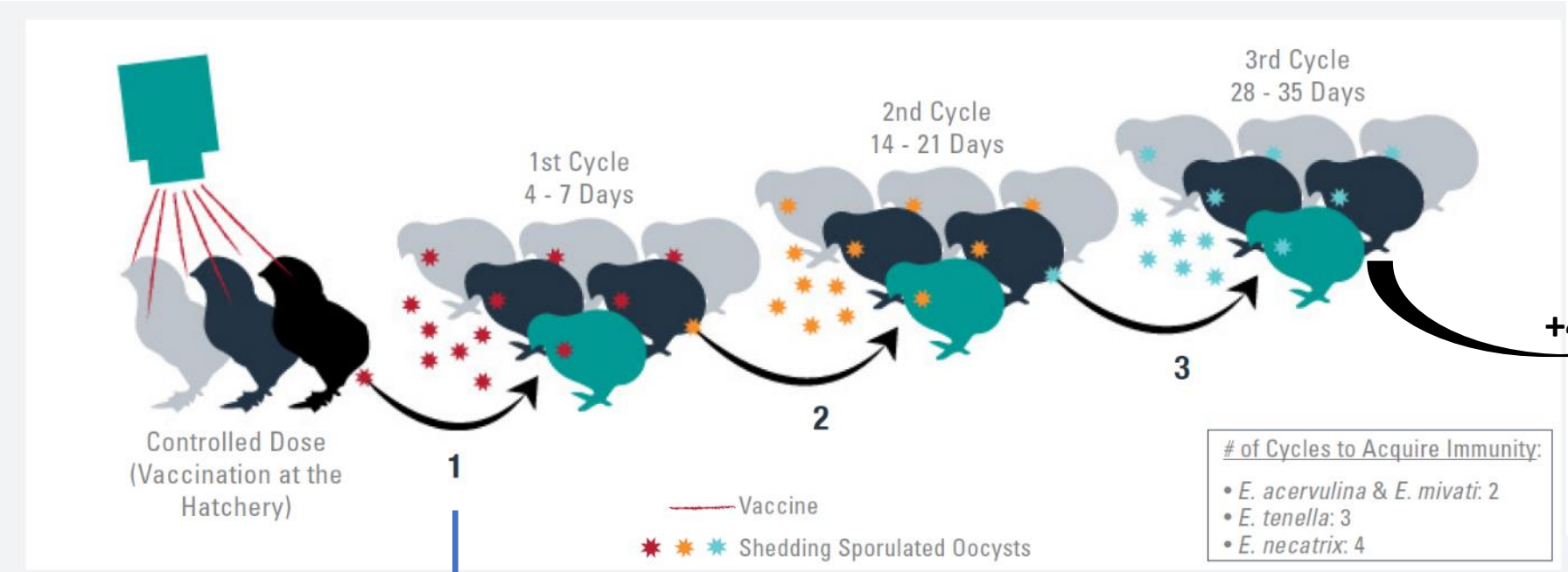
Source: Felipe Silva, 2020

Coccidiosis vaccination – immunity vs time



Source: Breeder Health Bulletin, Merck Animal Health, 2016.

Coccidiosis vaccination –proper cycling



Source: Breeder Health Bulletin, Merck Animal Health, 2016.

DAYS POST-VACCINATION

0 - 8 DAYS	0.5 ft² per bird
9 - 14 DAYS	0.75 ft² per bird
28 - 35 DAYS	1 - 1.75 ft² per bird

- "Transition from the first to the second cycle is critical"
- Second cycle oocyst will sporulate if litter:
  - Moisture is 25-35%
  - Temperature is 26-30°C
- Access to fed and water stimulate the release of sporozoites in the digestive track.

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Coccidiosis cycling – immunity development

- "Disruption in the process of going from the 1st cycle to the second will cause some birds to start building immunity, while others remain naïve to coccidia" (Bruzual and Marton, Aviagen 2022).

- Poor uniformity of immunity = ↑ risk of coccidiosis breaks / treatment with anticoccidials may be necessary.

- Treatments with **Amprolium** are not recommended after proper vaccine application, **should not** be used as a **routine** treatment. Breeders/Layers may fail to develop *E. necatrix/ E. brunetti* immunity. Use wisely.

Source: Felipe Silva, 2020

Coccidiosis cycling : comfort = proper cycling

Chick Placement

Recommended environmental conditions at placement:

- **Air temperature (measured at chick height in the area where feed and water are positioned):**
  - 30°C/86°F for whole-house brooding
  - 32°C/90°F at edge of brooder for spot brooding
- **Litter temperature:**
  - 28-30°C (82.4-86.0°F)
- **Vent temperature:**
  - 39.4-40.5°C (103-105°F)
- **RH:**
  - 60-70%

Air speed:

- maximum of 0.15 meters per second (30 ft per minute)

CO2:

- <3000 ppm

Feed:

- dust-free crumble or mini-pellet. A total feed amount of approximately 40 g (1.5 oz) per bird should be measured out and fed on the paper prior to chick placement

Water temperature:

- 18-21°C (64-70°F)

Drinkers:

Drinker Type	Broilers	Parent Stock
Nipple lines	12 birds per nipple	12 birds per nipple
Bell drinkers	6 per 1000 birds	8 per 1000 birds
Supplementary	10 per 1000 chicks	12 per 1000 chicks

Feeders:

- Feeder trays: 1 per 100 chicks for broilers or per 80 chicks parent stock and/or on paper occupying at least 80% of the floor

Litter depth:

- 2-5 cm (0.8-2 in)

Light intensity:

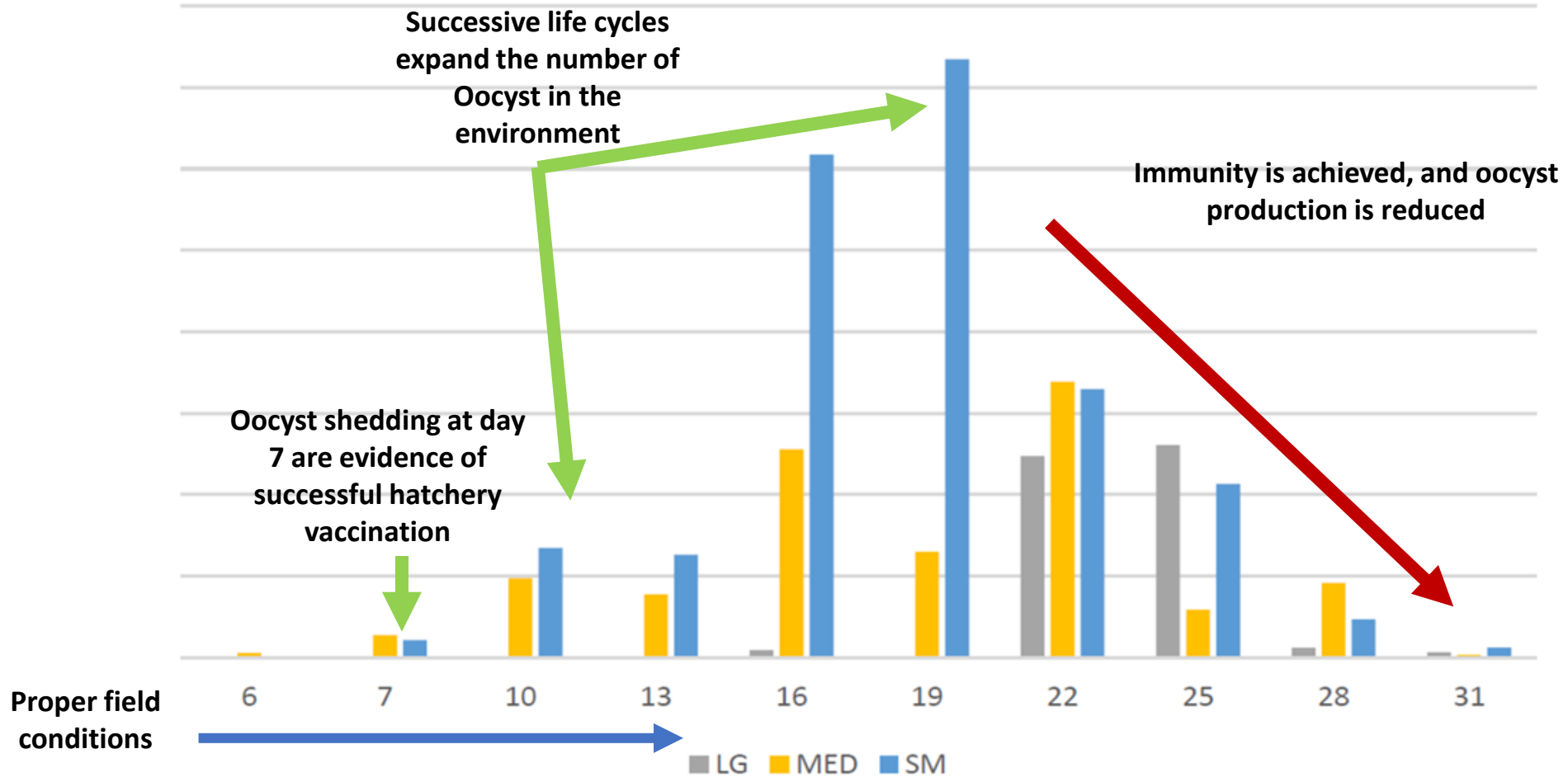
- **Broilers:** 30-40 lux (2.8-3.7 fc)
- **Parent Stock:** 80-100 lux (7.4-9.3 fc) in area with food and water and 1-2 lux (0.09-0.2 fc) in rest of house

Feed form:

Particle Size	Crumb/Mini pellet	Mash
> 3 mm	15%	25%
2-3 mm	40%	25%
1-2 mm	30%	25%
< 1 mm	< 10%	25%

Source: Brooding Equipment Checklist, Aviagen, 2020.

Coccidiosis vaccination – OPGs



Example of OPG overtime on a vaccinated flock with Coccivac.

Source: Graph OPG data, Felipe Silva, 2020 / Statements adapted from Mouw and Wilson, AAAP 2021.

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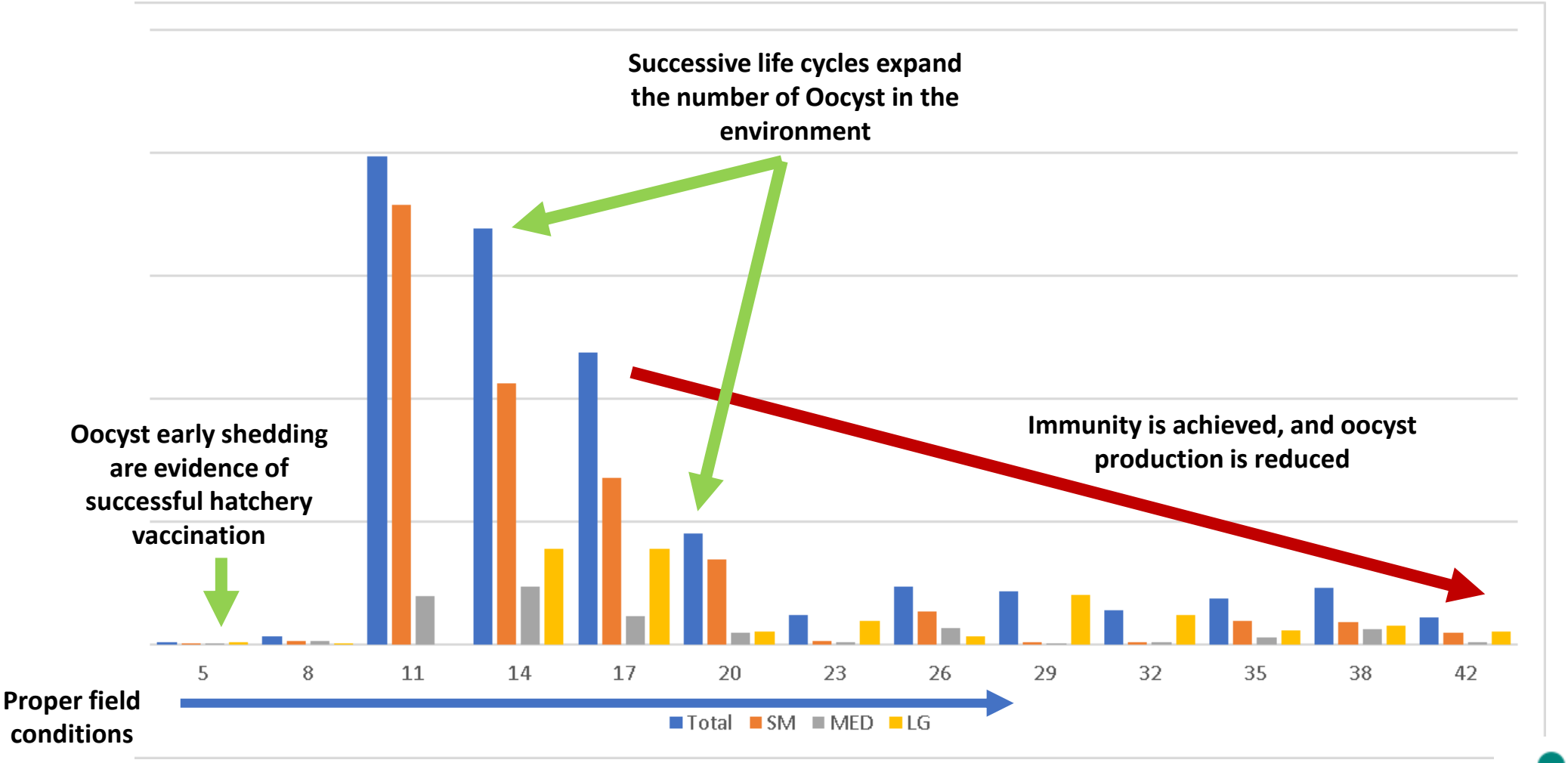
Coccidiosis vaccination – OPGs



Example of OPG overtime on a vaccinated flock with Coccivac.

Source: Graph OPG data, Felipe Silva, 2020 / Statements adapted from Mouw and Wilson, AAAP 2021.

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What to do when providing the proper conditions for “cocci” cycling is a challenge?

Source: Valli Volo - BABY AREA - Valli (valli-italy.com)

Coccidiosis vaccination – Layer issues

- "Heat and moisture may not be at appropriate levels in many pullet management systems. Access to feces may also be difficult in cage-type rearing facilities" (Mouw and Wilson, WPDC, 2021).
- Major challenge is rearing paper moisture build-up and management, which include:
    - Keep rearing papers up to 30 days
    - Move papers (with the feces on it) when flock is split
    - Increase RH in pullet facilities.

  (Adapted from Jim Stockman – Merck Animal Health 2021)

- Cage free pullets and layers outbreaks are usually due to breakdowns in litter management which override coccidiostat and gut health medication programs. (Gingerich, October 2022 Layer Health Report)

Source: Felipe Silva, 2020

Coccidiosis vaccination

COCCIVAC®-D2

Merck Animal Health

COCCIDIOSIS VACCINE

Live Oocysts

DIRECTIONS FOR USE, READ CAREFULLY

DESCRIPTION

This product contains live oocysts of the following species of coccidia: *Eimeria acervulina, E. brunetti, E. maxima, E. mivati, E. necatrix* and *E. tenella*.

INDICATIONS FOR USE

This product has been shown to be effective for the vaccination of healthy chickens 1 day of age or 4 days of age against coccidiosis due to *E. acervulina, E. brunetti, E. maxima, E. mivati, E. necatrix* and *E. tenella*. Duration of immunity has not been established. For more information regarding efficacy and safety data, see **productdata.aphis.usda.gov**.

VACCINATION PROGRAMS

Many factors must be considered in determining the proper vaccination program for a particular farm or poultry operation. To be fully effective, the vaccine must be administered to healthy receptive chickens held in a proper environment under good management. In addition, the response may be modified by the age of the chickens and their immune status. Seldom does one vaccination under field conditions produce complete protection for all individuals in a given flock. The amount of protection required will vary with the type of operation and the degree of exposure that a flock is likely to encounter. For these reasons a program of periodic revaccination may be required.

Source: Canadian Label for COCCIVAC®-D2 (Merck Animal Health)

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“Trickle” dose of Coccivac®-D2

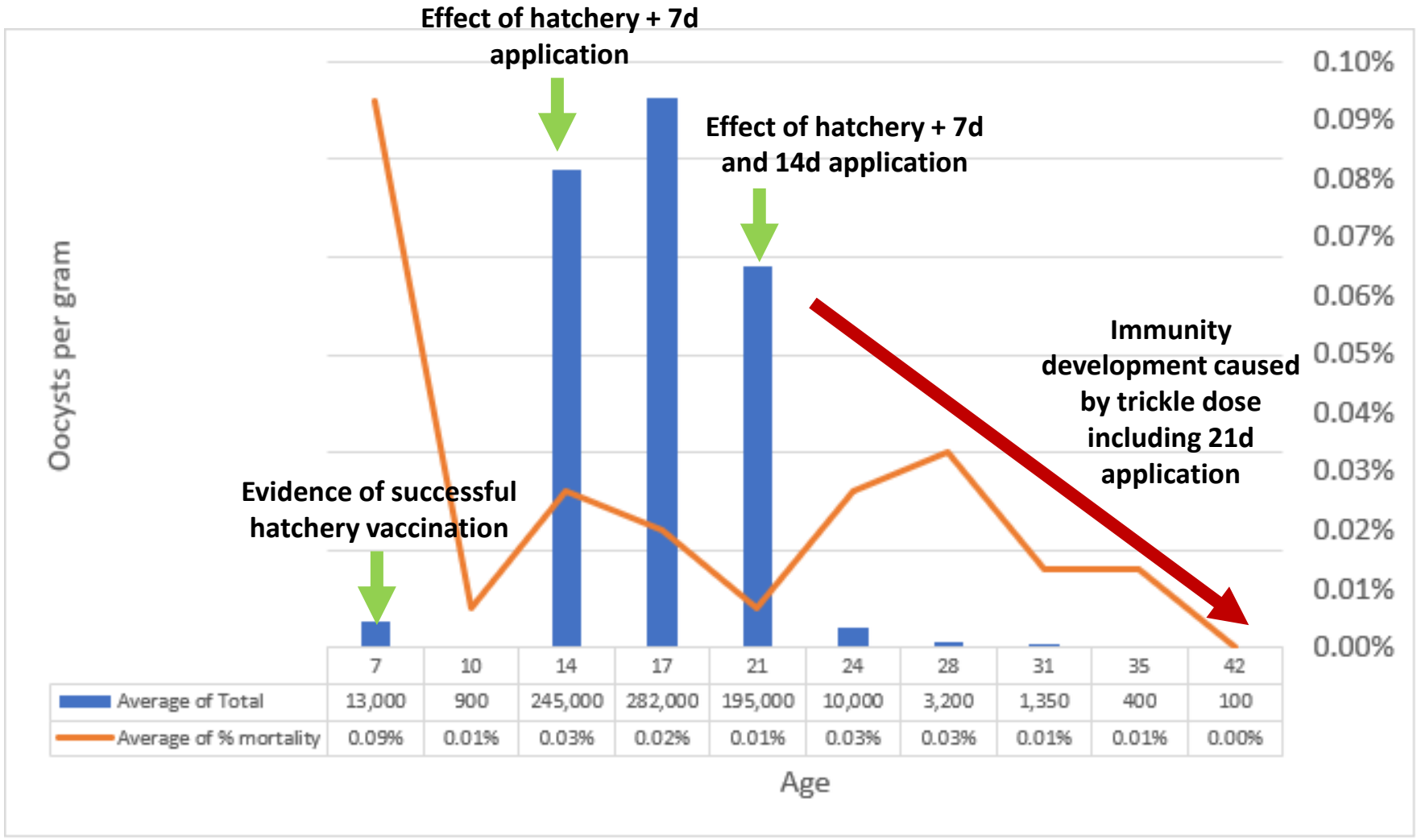
- Besides hatchery application, apply the vaccine sprayed directly on feed (with backpack sprayer).

- Application of 1/3 dose at day 7, 14, and 21 to mimic fecal cycling (remove rearing papers, plates, etc. day 7-9 of age). (Mouw and Wilson, WPDC, 2021; Jim Stockman – Merck Animal Health 2021 ; Gingerich, October 2022 Layer Health Report)

- Dilution rate should be based on complete coverage of feed lines (trial run). Proper application only dampen the surface of the feed. (Use of dye is recommended).

Source: Jim Stockam, Merck Animal Health 2021.

Trickle dose coccidiosis vaccination – OPG's



	7	10	14	17	21	24	28	31	35	42
Average of Total	13,000	900	245,000	282,000	195,000	10,000	3,200	1,350	400	100
Average of % mortality	0.09%	0.01%	0.03%	0.02%	0.01%	0.03%	0.03%	0.01%	0.01%	0.00%

Source: Merck Animal Health, 2022

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Coccidiosis trickle vaccination – a reasonable investment

- Results has shown protection on vaccinated birds. (Mouw and Wilson, WPDC, 2021; Jim Stockman – Merck Animal Health 2021).
- Successfully used in USA on all type of pullet facilities (floor, cages, aviary). (Jim Stockman – Merck Animal Health 2021)
- Real cost savings comes from lower mortality and better overall status on the bird health (uniformity, weight curve, etc.).

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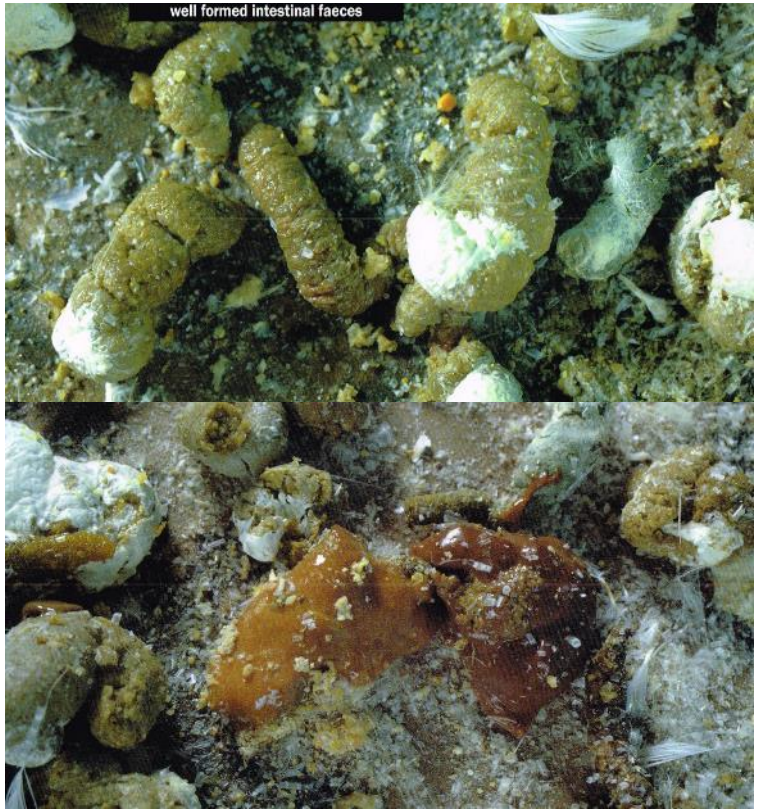
Key points

- Implement actions to favor humidity and moisture in the farm.
- Pursue optimal brooding practices for proper oocyst cycling, avoid litter peckers.
- Litter moisture measurements should be considered as a normal practice, target at min of 25% (day 4-7, and so on…).
- Manage brooding (partial, rings, partitions, etc.) based not only on density+water+feed but on shedding+sporulation+ingestion.
- Both males and females will benefit from same cocci management for the first 3-4 wk.
- Consider progressive and smooth changes on your programs (i.e., lighting, feed restriction program, diet change).
- OPGs? Why not?
- Watch (droppings, behavior, appearance, mortality, uniformity, etc.)
- Treatment and interventions should be evaluated with your veterinarian.
- Adapt these principles to your barn (every facility is different).



Worth checking documents

lhc-poultry.com

No. 01

BREEDER HEALTH

NEWEST TRENDS IN DISEASE MANAGEMENT AND NUTRITION

General Management Guidelines for Coccivac®-D2 in Floor-Raised Breeders

Figure 1. Standard growth house for broiler breeders.

Coccivac®-D2 contains six coccidia species (*Eimeria acervulina, E. brunetti, E. maxima, E. mivati, E. necatrix, and E. tenella*). It is intended for birds grown beyond eight weeks of age, such as commercial layers or broiler/layer breeder replacements.

Vaccination is designed to infect the birds at early age with a controlled number of organisms, which will ultimately elicit a solid immune response.

The following factors are critical to achieve a successful immunization of the pullets:

AT THE HATCHERY

- Recommended vaccine storage & handling
- Proper vaccine application (coverage)
- Adequate light & temperature conditions to promote preening

DAYS 1 - 5

Proper management and husbandry practices to create adequate conditions to favor coccidia cycling, such as:

- bird density
- continuous feed and water supply, and
- temperature and relative humidity

DAYS 5 - 28

- continue targeting controlled exposure (cycling) through adequate management and husbandry conditions

Remember: Effective vaccination programs against coccidia start with the ingestion of live sporulated oocyst after vaccine administration. Following initial controlled exposure, coccidia must achieve subsequent life cycles in the bird for full immunity to develop.

KEY POINTS

- **Effective immunization programs start with a uniform ingestion of a controlled dose of sporulated oocysts of the different coccidia species soon after vaccination.**
- **Adequate management practices are critical to promote oocyst sporulation and eventual development of immunity.**
- **Development of immunity varies according to the coccidia specie and requires a continuous re-exposure to sporulated oocysts.**
- **The use of coccidiosis medication after vaccination is not recommended as a routine practice. It might affect vaccine cycling and development of immunity.**

MERCK Animal Health

https://www.merck-animal-health-usa.com/offload-downloads/breeder-health-newsletter-coccivac-d2-floor-raised

ROSS NOTE

Coccidiosis Control in Broiler Breeders with the use of Vaccines

Jose J. Bruzual, Senior Poultry Veterinarian and Zoltan Marton, Regional Technical Veterinarian

INTRODUCTION

Coccidiosis is a disease of the intestinal lining, produced by the invasion of the mucosal cells by a very prolific protozoan parasite of the genus *Eimeria*. This invasion results not only in the interruption of feeding and digestive processes involved in nutrient absorption but also can cause intestinal inflammation leading to dehydration, blood loss, loss of skin pigmentation, and increased susceptibility to secondary bacterial infections like necrotic enteritis and osteomyelitis.

Coccidia are prevalent in almost any poultry facility where chickens are raised. Although normally a disease of young chickens, any aged chicken without prior exposure and immunity is susceptible to coccidia.

In the past, clinical coccidiosis in broiler breeders was prevented by the use of anticoccidial medications (ionophores and chemically synthesized anticoccidials) in the feed. Then, after the worldwide introduction of commercial coccidiosis vaccines in the late '80s and early '90s, the strategy for coccidiosis control in long-lived birds was dramatically changed. Today, around 60-70% of breeder flocks are vaccinated at the hatchery, and the use of coccidiosis vaccines is commonplace whenever they are available. Vaccines are effective as long as they are managed and administered correctly and followed by adequate brooding practices to ensure the uniform cycling of coccidia within the flock. The objective when using a coccidiosis vaccine is for chicks to develop immunity early in their life with minimal intestinal damage.

EARLY IMMUNITY

When using a coccidiosis vaccine, achieving early immunity (within the first 3-4 weeks of a chick's life) is essential for ensuring long-lasting protection throughout their life. Vaccination at the hatchery is a controlled exposure method and the development of immunity to coccidia requires several consecutive cycles or passes through the bird in the field under particular management conditions.

The first exposure to the coccidia parasite takes place during vaccination. Regularly, this vaccination occurs at the hatchery, and the rest of the cycling process continues on the farm (following exposure and cycling).

Each cycle requires the ingestion of sporulated oocysts by the bird. The parasite invades and multiplies within the intestinal cells several times, and the cycle ends with the shedding of the unsporulated oocysts in the feces. Then, under the right litter conditions (oxygen, temperature, and humidity), the oocysts sporulate in the litter, ready to repeat the cycle.

BIOLOGY AND LIFE CYCLE

The coccidia of chickens have a distinctive life cycle (**Figure 1**). Previously unexposed chickens get infected by ingesting sporulated oocysts (infectious) to start the cycle, from either vaccination or the litter. The cycle is composed of two stages; the first stage occurs inside the chicken (Schizogony and Gametogony), lasting around 5-7 days. The second stage occurs in the environment/litter (Sporogony) and lasts around 1-2 days, and this enables the oocyst to become infective. A sporulated oocyst has 4 sporocysts, and each sporocyst contains 2 sporozoites. After ingestion, the oocysts' walls are crushed by the physical activity in the gizzard, which releases the sporocysts (excystation process). Pancreatic enzymes in the small intestine then release the sporozoites from the sporocysts enabling them to infect epithelial cells and begin the cycle in the intestine of the bird.

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1

https://en.aviagen.com/assets/Tech_Center/Ross_Tech_Articles/Ross-TechNote-CoccidiosisControl-in-BroilerBreeders-2022-EN.pdf

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THANK YOU!

Felipe Silva MV MSc.
Poultry Specialist, Western Canada
felipe.silva1@merck.com
Cell: (587) 335-3036

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