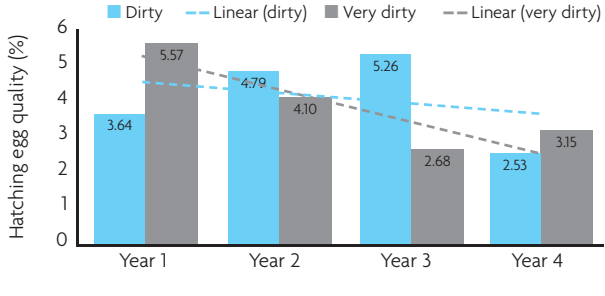
1 – Every Egg Counts

Performance improvement is a common target for all poultry producers worldwide. In order to reach this target, the production process needs to be reviewed in detail, **starting by monitoring hatching-eggs quality which directly influences chick quality**. It is well known that healthy chicks come from good quality hatching eggs, and those healthy chicks will perform better. **Therefore, every egg counts.**

When discussing the production of hatching-eggs, many parameters are influenced by **genetics**, for example the number of eggs per hen, egg size, shell quality, and albumen to yolk ratio. **Feed composition and feed restriction management** at breeder farms are also key factors affecting hatching-eggs production.

Moreover, to maximise hatchery performance the impact of **hatching-eggs classification** should not be underestimated. In order to control this, **a continuous improvement plan for monitoring hatching-eggs classification is required**. The plan must set clear objectives, design actions and responsibilities for each action. A key aspect is to have a system in place to monitor whether each objective has been met. Fig. 1 below shows a case where the percentage of dirty and very dirty eggs was systematically observed on arrival at the hatchery over four years. The follow-up of these parameters indicates the success of a continuous improvement plan implemented over the years. The plan was implemented by a poultry producer in Europe having the monthly support of Ceva's in ovo C.H.I.C.K. Program services linked to the Egginject in ovo system. **The plan aimed to improve the hatchery performance through the monitoring of hatching-eggs classification from the breeder farms.** The aim was to give clear indications of what types of eggs were consistent with the standard, prioritising discarding the very dirty eggs, and establishing rewards according to achievements. **Results showed that the prevalence of very dirty eggs decreased by approximately 1.5% in the first year and almost 2.5% over the total four years.** Considering that very dirty eggs are highly susceptible to generating rotten eggs and reducing hatchery hygiene and performance, the improvement plan contributed to the hatchery performance as it maximises the number of quality eggs entering the setters, which is of particular importance when an **antibiotic-free policy is in place. Therefore, the control of the percentage of dirty and very dirty eggs on arrival at the hatchery is paramount.** Finally, the monitoring of egg quality included in Ceva's C.H.I.C.K. Program helps poultry producers to follow up the efficacy of the plan, while making fact-based decisions.

Fig. 1. Monitoring of hatching-eggs quality (%) over four years in a EU hatchery.



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2 – New candling technology

Less than 1% mortality at seven days is the golden rule for any poultry producer. However, since the current trend is for an antibiotic-free policy, this target has become more difficult to achieve. This continuous exposure to market pressures means producers must maximise efficiency to control each detail of the production chain.

Any small deviation implies a big gain or loss at the end of the year. In a hatchery context, a little deviation in breeder management, handling of floor eggs, hatching egg disinfection or hatchery hygiene, will highly impact early health, even more so when in ovo vaccination is conducted.

But even in an individual hatchery, this will vary from one breeder flock to another. And, if this is not enough, even the age of the breeder flock matters, as the older the flock the thinner the eggshells will be, making them more susceptible to contamination and the generation of explosive eggs.

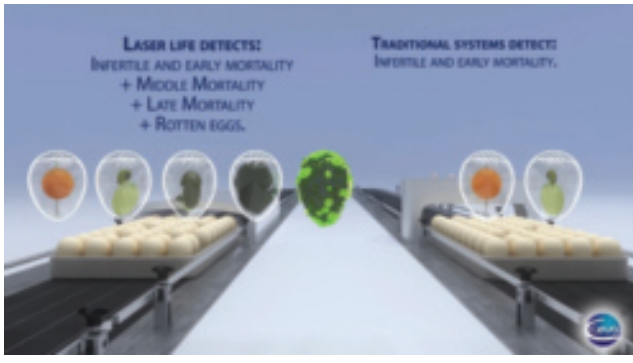
The role of the so-called explosive, banger or rotten egg in early health is critical. Striving to reduce the prevalence of rotten eggs by following all the recommended good practices to reduce floor eggs, is not always enough. It is unavoidable that some bangers will reach transfer. Their explosion will spread the contamination inside, compromising early health as embryos are very sensitive to contamination. Therefore, avoiding in ovo vaccination and/or the transfer of rotten eggs improves bacteriological pressure and reduces the risk of late embryo mortality.

Not long ago the removal of rotten eggs at transfer used to be an operator dependant process. However, in the last four years, the new technology of Laser Life candling became available on the market and is making a big difference.

Laser Life is able to identify dead and contaminated eggs. Later on the system can selectively inject in ovo and transfer only live embryos to the hatchers, while dead and rotten eggs remain untouched throughout the whole process (including the identification phase).

New Laser Life candling technology has been welcomed in the market among those poultry producers willing to maximise their performance. Laser Life improves early health and helps with antibiotic-free production thanks to the removal of contamination.

New Laser Life candling technology.



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3 – Embryo development

Ensuring vaccine delivery at the right site is paramount when performing in ovo vaccination because vaccines will behave differently according to which compartment inside the egg they are delivered into. For successful field protection, target locations are intra-embryo or amniotic fluid.

Last days of incubation

During the last days of incubation significant changes in embryo metabolism and positioning take place. Progressively, the yolk is internalised into the abdomen, the existing amniotic fluid is swallowed, and the embryo positioning changes from the head located between the legs, to the hatching position with the head under the right wing. As a consequence, the proportion of the different compartments inside the eggs varies and, depending on the in ovo injection time, the probability of delivering the vaccine into one compartment or another also changes.

Optimum embryo development and flock homogeneity at in ovo injection time

To maximise in ovo vaccine delivery in target protective locations, the optimum injection time is 18.5-19.0 days of development (Mean >18.5), being a range between 18-19 days of development suitable for in ovo. At this range, intra-embryo and/or amniotic locations are maximised ensuring field protection. Embryos below or above optimum development will have a higher risk of poorly located vaccine. Below, there will be a higher risk of vaccine delivered into the allantoic fluid. Above, there will be a higher risk of delivering vaccine into the feathers and skin. Neither location is protective. Note, in ovo vaccination is conducted in a population of embryos, therefore flock embryo development homogeneity is critical as well. Flocks with the same embryo development mean might have different distribution curves and it will influence the percentage of embryos out of the recommended embryo development range. In other words, the higher the heterogeneity of embryo development within a population, the higher the risk of delivering vaccine in an undesirable and not protective location. Therefore, embryo development homogeneity is key to ensure vaccination efficacy.

Incubation hours and physiological development

Many factors influence the incubation hours needed to reach the recommended physiological development at injection time. For example, 18.5 days of incubation does not necessarily result in embryos with 18.5 days of development because it depends on the type and breeder flock age, single or multi stage incubators, incubation parameters, hatching egg storage time and conditions, among others. Consequently, in ovo vaccination timing should be ruled by the physiological development of the embryos, not necessarily by the incubation hours given.

Summary

Ensuring vaccine delivery at the right embryo site is paramount when performing in ovo vaccination and it depends on the embryo development and flock homogeneity at injection time. While the embryo development average will define in ovo vaccination timing, flock homogeneity will define the in ovo vaccination quality. This is why regular embryo age diagnosis during in ovo vaccination is a critical control point to monitor the efficacy of the process and consequently the protection of live production.

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4 – Improving chick quantity and quality at the same time

A good hatchery performance is not only based on the number of day-old chicks hatched, but in how those chicks perform later on in the field. It means that the highest hatching rate does not always necessarily mean outstanding chick quality. In fact, there are many practices that target increased hatchability that do not always necessarily mean an improvement in chick quality.

However, there is a practice that might improve the number of day-old chicks hatched (depending on the existing potential) that also definitely improves the early health of day old chicks; reducing exposure of live embryos to contamination.

There is a correlation between the prevalence of rotten eggs, and hatchability and chick quality. It is obvious that the explosion of rotten eggs increases the bacteriological load and creates more dirty eggs around them. However, this does not only negatively influence the sanitary status of the hatching eggs nearby. These eggs have the potential to impact the whole production due to environmental cross contamination during the transfer and hatch.

Consequently, the first extended practice to decrease the prevalence of rotten eggs is to avoid the incubation of floor eggs and eggs with a low eggshell quality. Strict classification of hatching eggs in origin and review at hatchery arrival is the key. The next step is to avoid the transfer of existing rotten eggs.

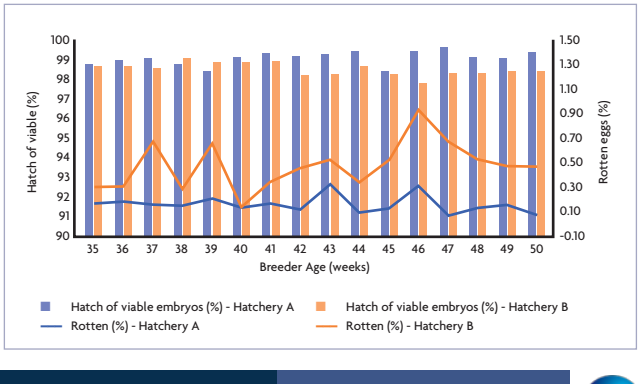
Traditionally, the removal of rotten eggs at transfer has been done manually in an attempt to reduce their impact during in ovo or in the hatchers. However, there are three critical points to consider:

- Not all the rotten eggs are visible to the naked eye
- It is an operator dependent process
- Most of them explode when they are touched

Today, thanks to Laser Life candling technology, it is possible to accurately transfer and vaccinate in ovo only live embryos, while rotten eggs remain untouched in the incubation trays. Through careful analysis of heat emission, in addition to laser technology, up to 99.8% of live embryos can be accurately identified and classified as clear eggs, dead embryos, rotten eggs or live embryos, all without touching them.

Then, only live embryos are selectively injected in ovo and/or transferred to hatch, allowing the hatcheries to maximise early health and comply with the highest biosecurity and safety standards.

Fig. 1. Hatchery performance comparison according to rotten egg prevalence.



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5 – Monitoring of egg setting quality

It was in 1990 when the article 'Effects of setting eggs small end up on hatchability' was published in British Poultry Science by F. Bauer, S. G. Tullett and H. R. Wilson. And 30 years later, the fact that upside down eggs have lower hatchability and chick quality has not changed. When vaccinating in ovo, there is no doubt they will die. If there is no in ovo vaccination, there could be a discussion about how much lower the hatchability of those eggs will be, but it cannot be denied that the embryo needs extra effort to come out from an egg set upside down regardless of whether it survives or dies in the attempt. One way or another, early health will be impacted.

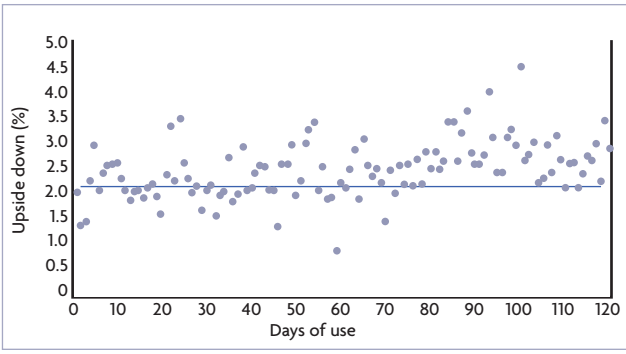
At any level, human or animal, physical efforts require a large supply of oxygen. The hatching process is no different. During incubation, oxygen is supplied by the chorioallantois membrane through gas exchange. However, during hatching, at the same time as the oxygen demand increases due to the physical effort required to hatch, progressive transformation from the oxygen supplied via the chorioallantois membrane to gas exchange through the lungs happens. Therefore, between the internal and external pipping period, another source of oxygen becomes necessary – the air chamber.

When hatching eggs are set correctly, the embryo head is located towards the air chamber so the oxygen needs during pipping will be covered. On the other hand, if the head position does not match with the air chamber location, which happens when eggs are set upside down, oxygen access will be limited. This leads to mortality or exhausting hatching due to the extra effort required. As mentioned, one way or another early health will be impacted.

The prevalence of upside down eggs varies from 1-3% from one hatchery to another. It means, on average 1-3% of production struggles to hatch. Most of them will die in the attempt, but if they survive their early health will not be optimum.

Today, unique Ovosense technology is available to identify upside down eggs before incubation and to give 100% of the fertile eggs the chance to produce a good quality day-old chick. In such a high competitive poultry market, the unique Ovosense egg setting analyser brings a clear competitive advantage to those producers looking for efficiency.

Fig. 1. Prevalence of upside down eggs corrected thanks to the Ovosense Egg Setting Analyser. Hatchery Capacity 1M eggs/week. EU 2019.



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6 – Subcutaneous injection or in ovo?

Over the last decade, the poultry industry has gone through a huge trend change – switching from drinking water vaccination on the farm, to vaccination in the hatchery. In fact, nowadays, regardless of the production type, more than 85% of hatcheries worldwide conduct their vaccination process on site, whether subcutaneously and/or in ovo. There are two main reasons behind this and both of them target maximisation of field protection:

- Remarkable improvement in vaccination accuracy compared to drinking water administration.
- Wide improvement in operational control due to easier control of one place and one vaccination team, rather than hundreds of farms.

Looking in detail at hatchery vaccination, more than 60% of larger capacity hatcheries worldwide vaccinate by the in ovo route. The trend is stronger in larger capacity hatcheries yes, but in ovo vaccination and a certain level of automation is also applied in the 25% of small hatcheries thanks to the range of equipment designed for in ovo vaccination on a smaller scale.

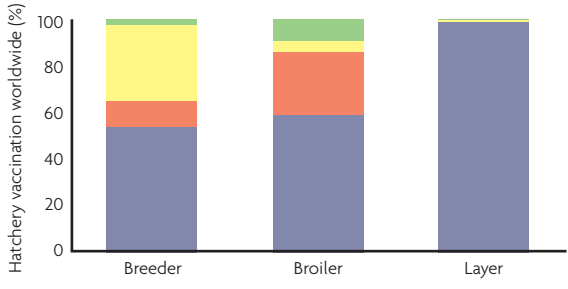
It has been demonstrated that hatchery vaccination has a very positive impact on vaccination accuracy and, therefore, field protection. However, successful hatchery vaccination requires:

- Fully trained operators.
- Accurate and effective equipment.
- Good process and biosecurity.
- An audit and monitoring plan.

This is why Ceva Animal Health offers a full solution to customers, based on a wide portfolio of vaccines, proven and innovative hatchery vaccination equipment, and a unique internationally recognised hatchery vaccination monitoring and reporting program through their C.H.I.C.K. Program with over 175 professionals exclusively dedicated to hatchery vaccination.

Fig. 1. Hatchery vaccination worldwide.

	Breeder	Broiler	Layer
None	2.53	9.40	0.62
In ovo +SQ	32.91	4.49	0.62
In ovo	10.13	22.93	0.00
SQ	54.43	63.18	98.77



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7 – Improving breeder hatchability

Healthy chicks come from good quality eggs. However, egg quality varies from breeder flock to breeder flock and the age of the breeders also plays a role. This is not only because when breeders get older the quality of the eggshell decreases, but is also due to a decrease in the sanitary status of the nests where the eggs are laid.

Moreover, when it comes to floor eggs, a healthy chick will never hatch from an egg laid on the floor. In fact, increasing the number of viable hatching eggs by washing eggs deposited on the ground is counterproductive.

Dirty eggs, or apparently clean eggs that have been exposed to a high microbial load in the nest, are susceptible to generating rotten eggs, even more so if the quality of the shell is not optimal. During incubation, gas-generating bacteria inside the eggs multiplies exponentially and with any vibration the eggs can explode, spreading their entire bacterial load to surrounding embryos with a consequent decrease in hatchery performance or early health. This is the reason why proper hatching egg handling and classification is paramount at breeder farms and on arrival at the hatchery.

Hatchery managers strive to arrange incubation process logistics in order to minimise the risk of cross contamination from risky flocks to healthy flocks. In fact, as rotten eggs are more likely to explode at transfer due to egg handling, dedicated procedures must be implemented to manually remove as many rotten eggs as possible before in ovo vaccination or transfer to hatch.

However, rotten eggs that are identified by the naked eye might explode when they are manually removed by operators and others are perforated when vaccinated in ovo and touched when transferred. Therefore, the risk of cross contamination will significantly increase unless advantage is taken of existing technology on the market and all hatching eggs are firstly candled with Laser Life technology.

LaserLife candling provides a unique solution for differentiating all clear, dead embryos and rotten eggs from embryos that are alive without touching any of them. Consequently, this improves early health thanks to a reduction in contamination.

In fact, LaserLife candling technology, in combination with the new generation Egginject in ovo system, becomes the ideal in ovo vaccination process where only live embryos are selectively injected and transferred to the hatchers, while clear, dead and rotten eggs remain untouched throughout the whole process.

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8 – Hatchery biosecurity starts at the breeder farm

Hatchery biosecurity starts at the breeder farm. The quality of the eggs coming from the breeder farms, and especially the number of dirty and contaminated eggs, is a key criteria that has a major impact on the final level of biosecurity and performance obtained at the hatchery.

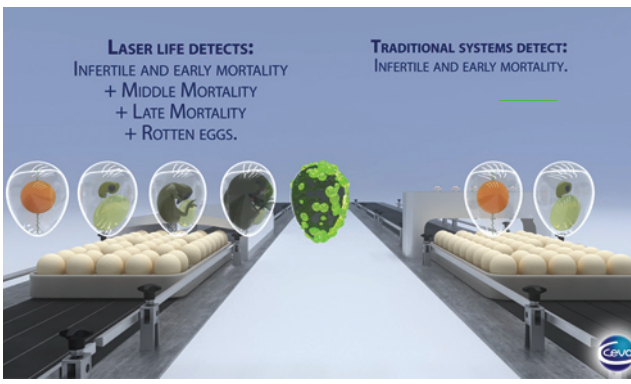
Dirty and contaminated eggs arriving at the hatchery will generate a contamination spread factor. Eggs located in incubation trays close to those dirty eggs and contaminated eggs will probably have some cross-contamination issues. This is especially important for explosive eggs.

It is very well known that one explosive egg can contaminate several trays of eggs located just above and below the setter tray. This is even more dangerous when it happens in the hatch baskets, and during the hatch process, as one explosive egg will cross-contaminate thousands of healthy chicks in the hatcher.

Biosecurity starts with the reception of eggs, but the most important phase to tackle explosive, contaminated and dirty eggs is at the time of transfer. If those eggs are identified and removed before transfer to hatch baskets then a clean hatch will be guaranteed, and the chick quality and first week mortality of those flocks will improve significantly.

This is exactly what Laser Life is designed for. Clean hatch, better chick quality and better first week mortality.

Fig. 1. The benefits of the Laser Life system.



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