EURCAW *Poultry SFA*

French Reference Centre for Animal Welfare

Selection of the most appropriate depopulation method for the welfare of poultry

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Contents

General considerations

The following set of decision trees aims to provide a clear and consistent framework for selecting the most appropriate depopulation method for poultry in the case of Avian Influenza (AI) by ultimately prioritizing animal welfare. For each depopulation method, the present document details the human, technical, and environmental resources required to ensure its implementation in accordance with poultry welfare. The overall priorization of the methods is made under the assumption that all resources are available (unless otherwise indicated). As such, methods that minimize poultry pain, distress, and suffering are ranked higher – without considering the likelihood of resource availability within a specific depopulation context (e.g., individual killing methods are considered technically feasible even on flocks with tens of thousands of birds). When two methods are deemed comparable from an animal welfare perspective, practical considerations can then be taken into account to rank them differently.

The set of decision trees has been designed as a live document based on the scientific knowledge and commercial equipment currently available. It should be reviewed and refined over time to include the latest scientific and technological progress. Only depopulation methods considered in the Council Regulation (EC) No 1099/2009 of 24 September 2009 on the protection of animals at the time of killing are discussed herein.

The decision tree is primarily intended for EU competent authorities, who should also consider matters that are not directly related to poultry welfare in their final selection of a depopulation method – such as the operators' safety (e.g., availability of personal protective equipment), the biosecurity, the availability of resources for carcass disposal, and the aesthetics and the public perception of the method used. Flexibility to the proposed guide should thus be maintained to accommodate specific situational requirements.

This deliverable was developed through a collaboration between the EURCAW-Poultry-SFA and the French Reference Centre for Animal Welfare.

Depopulation methods under study

Table 1 below summarizes the depopulation methods considered in the decision tree. The description and the operating procedures of each method can be found in the report of the EURCAW-Poultry-SFA entitled "Depopulation in case of Avian Influenza: Efficacy and welfare consequences of the depopulation methods used in the EU" (EURCAW-Poultry-SFA, 2025).

Depopulation method	Description
Whole-house gassing without foam	Administration of different gases such as CO_2 or N_2 into the house.
Partial-house gassing with CO_2 pellets	Administration of CO_2 pellets in a pen gathering a group of poultry, that is immediately covered with a plastic sheet.
Gassing in gradually-filled containers	Poultry are moved outside the house and placed in containers (EFSA, 2019a) that are gradually filled with a gas or mixture of gases. This process is usually performed using a containerized gassing unit, i.e., a gas-tight metal container fitted with a gas delivery system in which the birds are inserted in modules (i.e., cages often openable from the side).
Gassing in pre-filled containers	Poultry are moved outside the house and placed, in layers, in containers from the top openings. The container is pre-filled with gas at a pre-determined concentration before the first layer of birds is inserted. After a certain period of time (when unconsciousness of all birds is assumed), the next layer of birds is introduced. The process is repeated until the container is full. The concentration of gas is then set to target concentration to induce the death of all the birds.
Lethal injection	Birds are injected with a lethal dose of veterinary medicines (Council Regulation (EC) No 1099/2009 of 24 September 2009 on the protection of animals at the time of killing)
Cervical dislocation	Simultaneous stretching and twisting of the bird's neck, which results in the separation of the skull from the spinal column and the severance of the carotids (Martin, 2015; EFSA, 2019a). Alternatives to this instruction do not fall under the scope of this work and should not be used for welfare reasons (e.g., neck crushing equipment should never be used). Two types of procedures can be distinguished: manual and mechanical cervical dislocation. Unlike manual cervical dislocation, which is only performed using hands, mechanical cervical dislocation involves the use of any kind of tool to (aid to) perform cervical dislocation (Martin et al., 2018).
Non-penetrative captive bolt stunner	Birds are individually shot using a non-penetrative bolt, leading to severe damage of the brain. Legally, this method is considered as a simple stunning method (Council Regulation (EC) No 1099/2009 of 24 September 2009 on the protection of animals at the time of killing)). According to scientific evidence, the use of captive bolt only is sufficient to induce death, when captive bolt stunners are properly used (EFSA, 2019a).
Manual blunt force trauma	Firm and accurate blow to the head of a bird (Council Regulation (EC) No 1099/2009 of 24 September 2009 on the protection of animals at the time of killing) delivered with a hard tool of sufficient mass and with enough velocity to render the bird irrevocably unconscious. When the blow is delivered, the head of the bird should be as still as possible, and restrained if deemed necessary.
Electrical waterbath	The entire body of the bird is exposed to a current generating a generalised epileptic form on the EEG and possibly the fibrillation or the stopping of the heart through a waterbath (Council Regulation (EC) No 1099/2009 of 24 September 2009 on the protection of animals at the time of killing).
Head-to-body electrical killing	Exposure of the body to a current generating at the same time a generalised epileptic form on the EEG and the fibrillation or the stopping of the heart (Council Regulation (EC) No 1099/2009 of 24 September 2009 on the protection of animals at the time of killing).

Head-only electrical stunning (followed by a killing method)	Exposure of the brain to a current generating a generalised epileptic form on the electro-encephalogram (Council Regulation (EC) No 1099/2009 of 24 September 2009 on the protection of animals at the time of killing), followed by a method ensuring the death of the birds (e.g., cervical dislocation).

Table 1: Short description of the depopulation methods considered in the decision tree

Methods

From October to November 2024, the EURCAW-Poultry-SFA organized a series of focus groups, specific to different depopulation methods. The aim of the focus groups was two-fold:

- To identify the technical, human, and environmental requirements for the implementation of the depopulation method(s) under study while ensuring a satisfactory level of poultry welfare
- To identify the farm and bird characteristics where the depopulation method(s) under study could be applied while ensuring a satisfactory level of poultry welfare

In total, 8 focus groups of 2-hours were conducted, each gathering between two and five experts on the depopulation method(s) under study. Gassing in gradually-filled and pre-filled container were discussed as potential depopulation methods during the same focus group. Likewise, all three electrical methods (electrical waterbath, head-to-body electrical killing and head-only electrical stunning followed by a killing method) were successively discussed during the same focus group.

In December 2024, a three-hour meeting was organized with seven depopulation experts to further clarify certain points previously discussed during the different focus groups and to clarify the reasons for which certain depopulation methods are considered more welfare-friendly than others by the experts.

Rationale for the decision tree

The reasoning behind the ranking of the decision tree is based on the information gathered from the experts during the different meetings. The ideal depopulation method is one that induces immediate death and minimizes poultry pain, distress and suffering (e.g, no handling required). The reasoning for the elaboration of our decision tree is detailed below, by explaining the pros and cons of each depopulation method in terms of poultry welfare. The methods below are described in order from the most (1) to the least preferred (11), a priori:

1. **Non-penetrative captive bolt stunners.** The use of non-penetrative captive bolt stunners is considered as (one of) the best depopulation methods for poultry welfare and should always be preferred over other methods when the resources (e.g., stunners) necessary for its implementation are available. Non-penetrative captive bolt stunners induce immediate death and can be applied near the location of the flock (e.g., either on the spot, or where the restraining device – if used – is installed), thereby reducing handling stress. As any other individual killing method, it offers the possibility for individual death assessment, therefore ensuring that a back-up killing method (or a second shot) can be immediately applied if needed. Restraining of poultry is, however, necessary (using cones or by wrapping large birds in towels, for instance, and by holding their beaks) and sometimes involves inverting or shackling the bird. Inversion and shackling can provoke compression of the heart and lungs – causing potential fear and pain in birds (EFSA, 2019b). Shackling can, in addition, compress the legs of the birds, thereby causing additional pain (EFSA, 2019b).

2. **Lethal injection.** Lethal injection is also considered one of the most suitable depopulation methods regarding welfare of poultry, and it should always be performed when the resources to do so are available (e.g., veterinarians, operators, lethal substance). Lethal injection induces poultry death under the syringe, but there is a lack of consensus among experts as to whether it results in immediate unconsciousness and death (as opposed to death within seconds). It also depends on the molecule used. Restraining of the birds is often required, but the birds can remain upright or in decubitus for the injection to be properly administered.

   Specific instance: Both captive bolt stunner and lethal injection are particularly indicated methods to depopulate ducks housed in cages for forced-feeding. Indeed, these housing systems are designed for easy access to the bird's head, and captive bolt shooting or occipital sinus injection can be easily done with very limited handling.

3. **Whole-house gassing.** Whole-house gassing is considered as one of the most humane depopulation methods since it does not require poultry handling. It also allows the killing of numerous birds at once, meaning that birds exhibiting AI symptoms do not have to wait a prolonged period of time before being killed (i.e., compared to being killed using an individual depopulation method taking more time). Whole-house gassing also minimizes the risk for virus spreading, as poultry remain inside the house. The induction of unconsciousness and death, however, takes several minutes regardless of the gas mixture used, and leads to aversive reactions when CO_2 is used. Convulsions in response to N_2 also occur, which may cause self-inflicted injuries or injuries and pain to the other birds that have not yet lost consciousness. In the case of hot weather conditions, whole-house gassing can also induce hyperthermia within minutes after the ventilation has been stopped.

   Specific instance: Whole-house gassing should be preferred over captive bolt stunners and lethal injections to depopulate farms with medium and large flocks of birds exhibiting AI symptoms, because it reduces the suffering of the birds due to illness. It is indeed highly unlikely that a sufficient number of captive bolt stunners or veterinarians will be available to kill thousands of birds as quickly as whole-house gassing would. Of note, certain species exhibit symptoms faster than others or more acute symptoms than others.

4. **Head-to-body electrical killing.** Head-to-body electrical killing induces near instantaneous unconsciousness (ideally within 100 ms) followed by death. It can be applied near the location of the flock (e.g., either on the spot, or where the device is installed), thereby reducing handling stress. The restraining of the birds in an inverted position is, however, required and potentially even shackling.

5. **Head-only electrical stunning followed by a killing method.** Head-only electrical stunning induces near instantaneous unconsciousness and can be applied near the location of the flock (e.g., either on the spot, or where the device is installed), thereby reducing handling stress. Handling of the birds is, however, required and often involves restraining

the birds in an inverted position – with potential shackling. Furthermore, the need to apply a killing method following the stun also introduces the risk of bird consciousness recovery before death. This risk of recovery can be prevented when the killing method is applied immediately following head-only electrical stunning.

6. **Gassing in gradually-filled containers.** Gassing birds in gradually-filled containers induces death within minutes. Compared to partial-house gassing (see below), gassing in gradually-filled containers allows for a greater control over the gas delivery, enabling the operators to monitor and optimize the process as required. If a problem arises (e.g., in the gas filling process), the birds can also be immediately removed from the containerized gassing unit – which is not possible when using prefilled containers. Handling of the birds is often necessary to bring the birds into the modules, although one-level flat module systems have been developed to allow for the corralling of floor-reared birds (especially ducks and turkeys) inside the modules without touching them. Aversive reactions occur when CO_2 is used either alone or mixed with another gas. Convulsions in response to N_2 also occur, which may cause self-inflicted injuries or injuries and pain to the other birds that have not yet lost consciousness.

   Specific instance: To minimize the unnecessary suffering of birds during prolonged periods, gassing using gradually-filled containers should be preferred over head-to-body electrical killing and head-only stunning to depopulate farms with medium and large flocks of birds exhibiting AI symptoms. It is indeed unlikely that a sufficient number of electrical devices will be available to kill thousands of birds as quickly as whole-house gassing would.

7. **Manual blunt force trauma.** When applied correctly, manual blunt force trauma induces immediate loss of consciousness and death, offers the possibility for individual death assessment and can be applied on the spot. The method does still require some handling and restraining of the birds, however for a relatively short period of time when applied on birds in situ. This method is ranked lower than head-to-body electrical killing and head-only stunning due to its higher susceptibility to errors during execution. Of note, manual blunt force trauma should be considered as a usable depopulation method only when used on small flocks. On medium and large flocks of birds, manual blunt force trauma should only be used sporadically on moribund individuals to immediately alleviate their pain, or as a back-up if the initially planned depopulation method has failed.

8. **Cervical dislocation.** Although cervical dislocation can be applied *in situ*, this method ranks low in the decision tree as it does not induce instantaneous death – even when correctly performed by well-trained operators (i.e., death still occurs after several seconds). Furthermore, cervical dislocation still requires poultry handling and restraining, although for relatively short period of time. As for manual blunt force trauma, cervical dislocation should only be considered as a viable depopulation method when used on small flocks. On medium and large flocks of birds, it should only be used sporadically on moribund individuals to immediately alleviate their pain, or as a back-up if the initially planned depopulation method has failed.

9. **Gassing in pre-filled containers**. Gassing birds in pre-filled containers should be avoided whenever any other methods (other than electrical waterbath) can be implemented more satisfactorily. Gassing birds in pre-filled containers involves the same welfare issues as gassing birds in gradually-filled containers, in addition to high risks of 1) pain from falling several meters down in the container and 2) smothering under other animals. The former issue can be addressed by, for instance, adding bedding materials in the container to cushion the fall of the birds from the first layer. The latter issue can be managed by carefully monitoring the gas concentrations and adjusting the loading speed of the birds inside the container to increase the likelihood that the previous layer of birds is unconscious before adding a new one.

10. **Electrical waterbath.** Electrical waterbath should only be used as a last-resort option, when all other methods cannot be applied. In contrast to other electrical methods applied individually (head-to-body killing and head-only stunning), electrical waterbath does not guarantee the equal distribution of current between the individuals on the line – which can affect the onset of unconsciousness and death, and trigger pain. This method also involves handling and shackling of the birds.

Non-ranked: Partial-house gassing with CO_2 pellets. To the best of the available knowledge, partial-house gassing with CO_2 pellets has only been developed in one member state and most consulted experts had limited experience with this method. Ranking it in a meaningful way based on welfare considerations in comparison to other depopulation methods would require more practical experience with the method. That being said, from the information gathered it appears that partial house gassing with CO_2 pellets induces death within minutes; but exposes birds to aversive levels of CO_2 and requires handling. If birds are floor-reared, handling can, however, be minimized by simply directing the birds into the gassing pen without physically touching them.

Decision tree

Figure 1 represents the prioritization of the different depopulation methods based on welfare considerations only (the best methods being written on top). The reader must refer to the method-specific decision tree of their interest (e.g., decision tree n°1 for non-penetrative captive bolt stunners) to determine whether all necessary resources are available for each method to be implemented under conditions designed to uphold a satisfactory standard of poultry welfare. If conditions are not met, the reader is advised to opt for the next best depopulation method that fulfills all the required criteria.

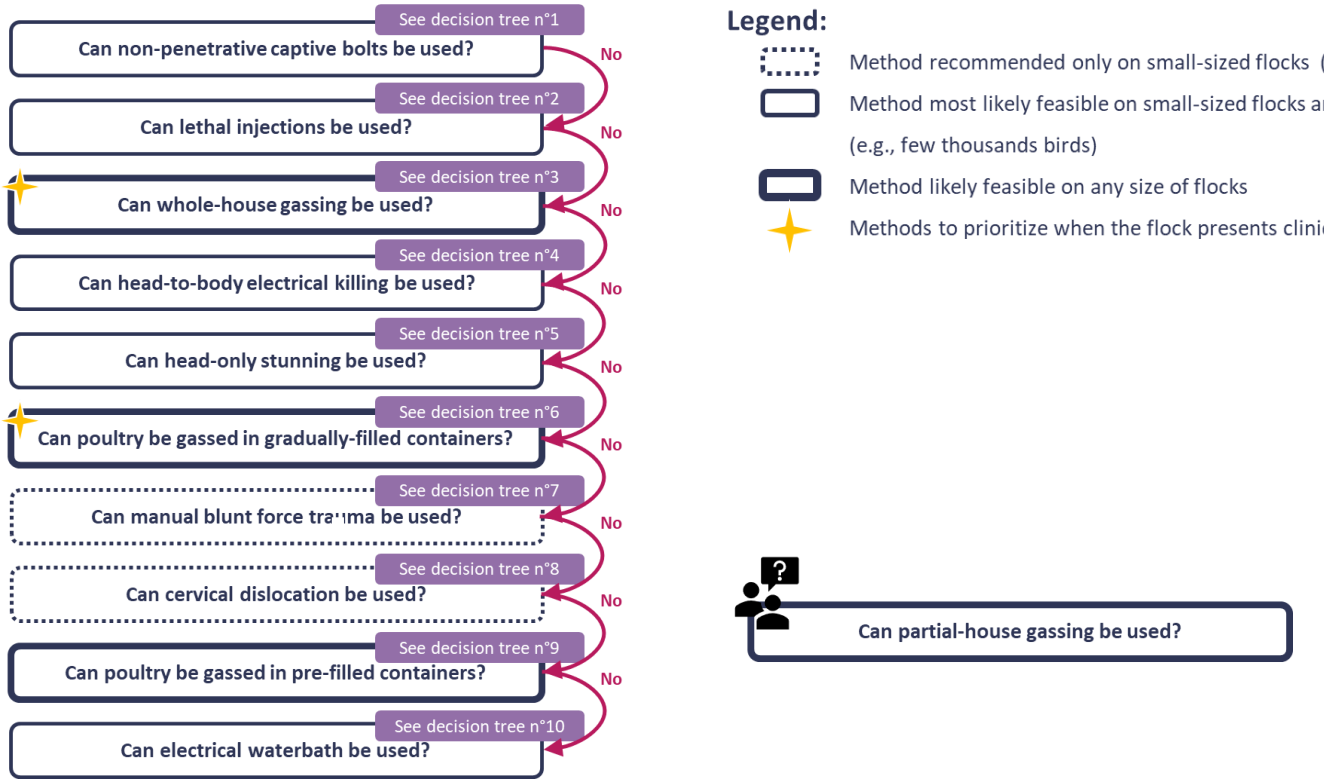
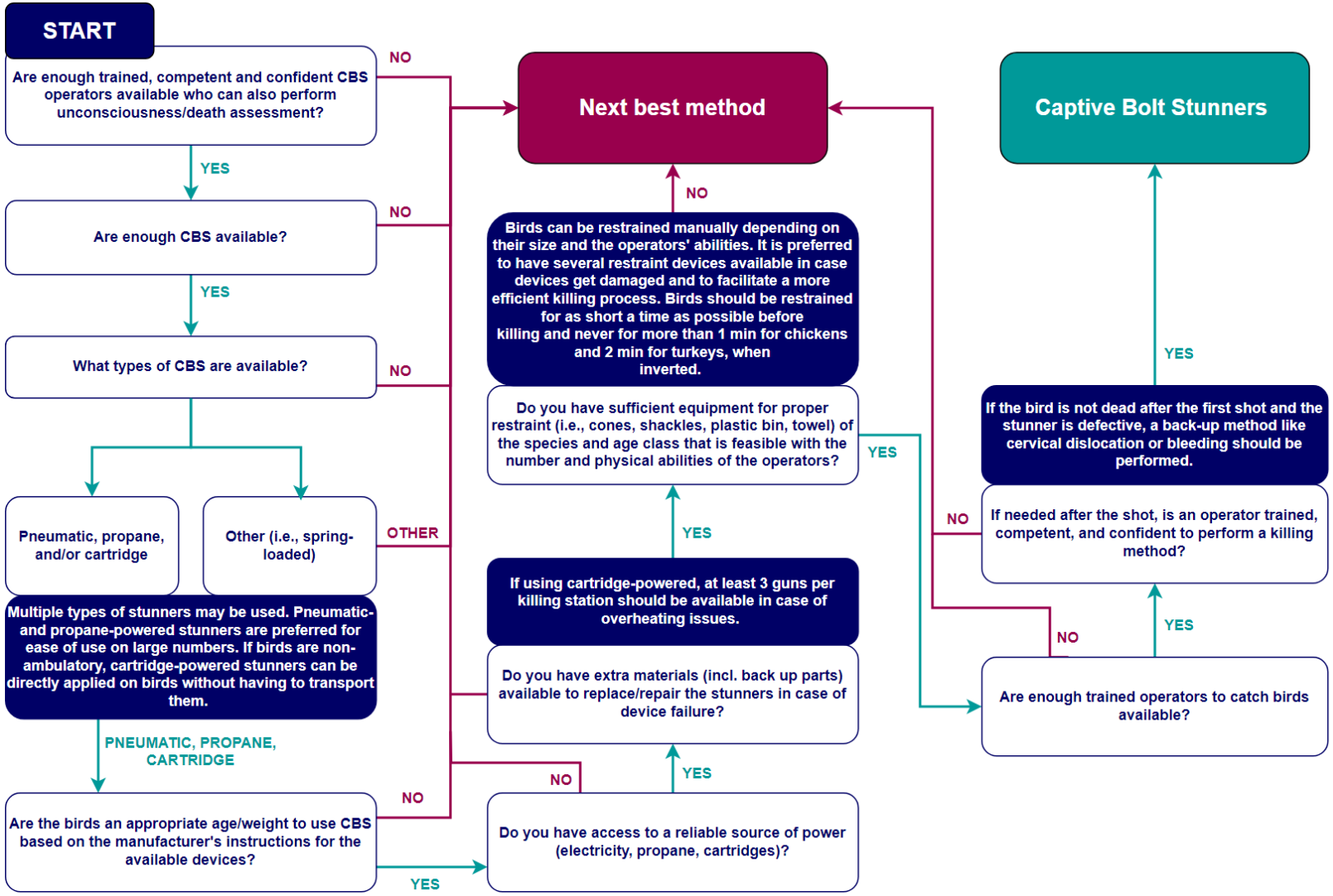


Figure 1. Priorization of the depopulation methods based primarily on welfare consideration. Partial-house gassing could not be ranked with certainty due to the lack of experience with the use of this method.

1.1 Decision tree n°1: Non-penetrative captive bolt stunners (CBS)



The green arrows in the decision tree indicate progression to the next question to be answered, while the red arrows signify that an alternative method must be considered.

Additional information:

Type of stunners: Penetrative captive bolts stunners are not considered within the scope of this document, due to safety concerns for the operators and their lack of effectiveness on poultry species (especially heavy ones) according to the questioned experts. The use of non-penetrative captive bolt stunners is recommended, except for spring-powered devices as a result of their low velocity which reduces their effectiveness. Regardless of the type of non-penetrative captive bolts, the effectiveness of the stunners may also be compromised in case of head scabbing as a result of feather pecking, for instance. An alternative depopulation method should hence be considered in the latter case.

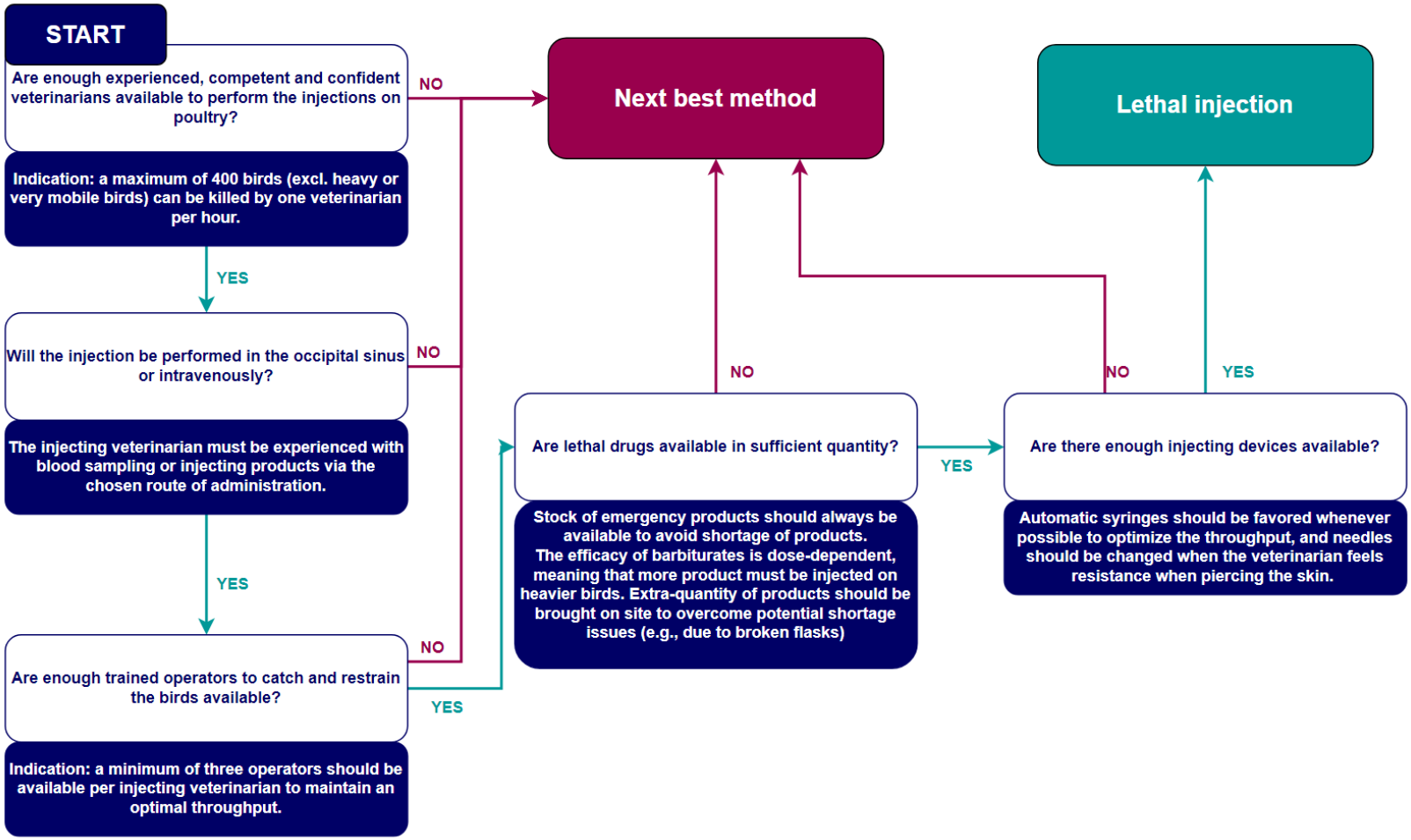
Restraining of birds: Different restraining techniques can be used to apply the shot on birds. The selection of the most appropriate technique should take into account the individual characteristics of the bird (weight, size, physical injuries), as well as the operator's physical ability. In particular, on-ground immobilization techniques (e.g., by wrapping the birds in towels) should be considered as alternative to the restraining of birds inside cones, especially for: 1) heavy birds to reduce the operator's fatigue and avoid escape attempts of birds (mostly turkeys) from the cones, and for 2) birds with leg/wing injuries to avoid compression of the injured body parts by the cone.

Position of the stunner: For all species, the muzzle of the CBS must be placed on the highest part of the head, in the midline of the skull, creating a 90° angle between the beak held by the operator and the (EFSA, 2019a). In the case of birds with large combs, fold the comb to one side and use the same gun positioning.

Environmental conditions: Cold weather can make the trigger of pneumatic stunners harder to pull due to changes in the compression of internal components, such as the microcellular buffer which can retain humidity.

Research gap: Comprehensive studies addressing the efficacy of various types of stunners across a broad spectrum of bird sizes and weights are limited. Further research is needed to establish specific animal categories for which the method is effective in inducing immediate unconsciousness.

1.2 Decision tree n°2: Lethal injection



The green arrows in the decision tree indicate progression to the next question to be answered, while the red arrows signify that an alternative method must be considered.

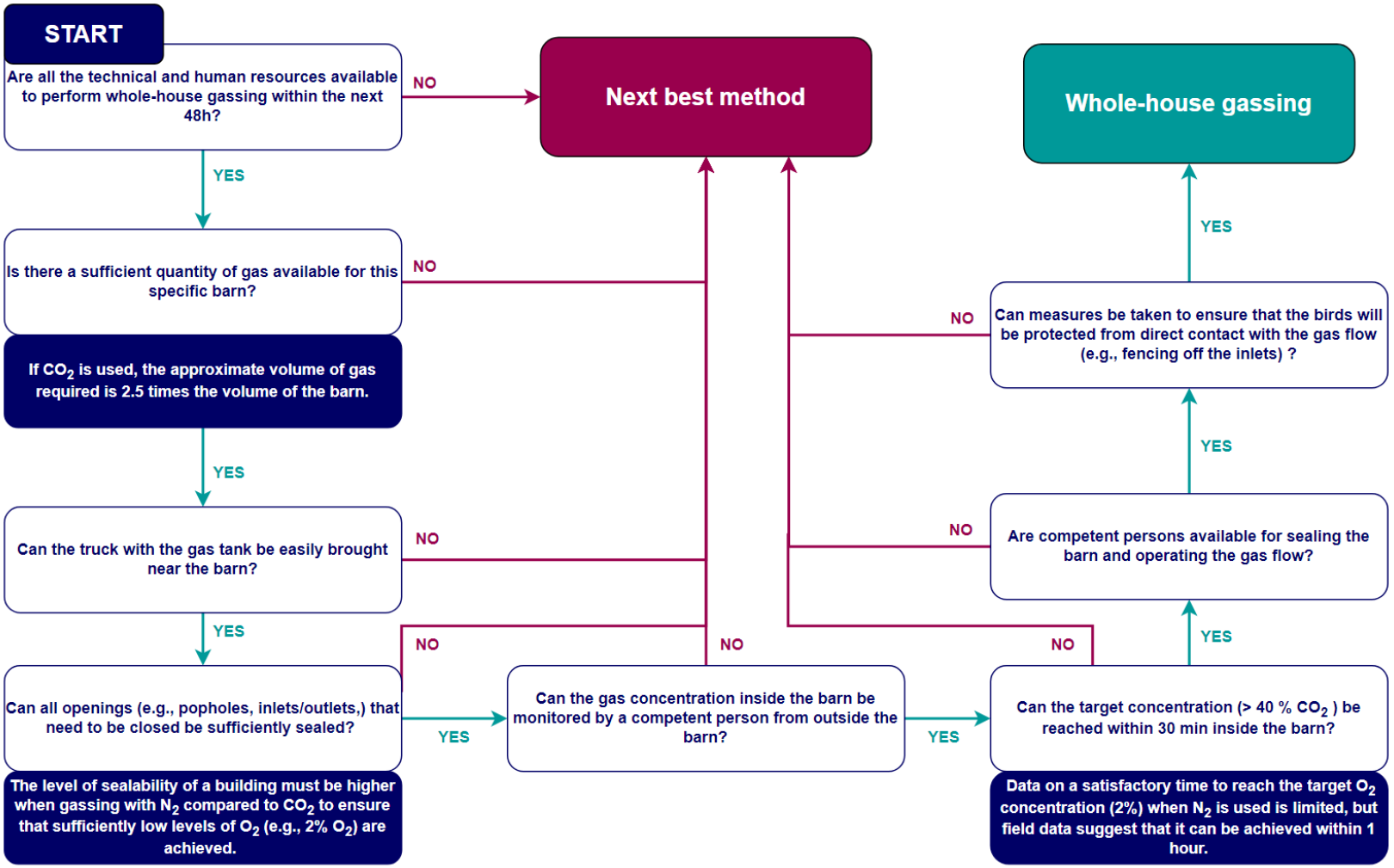
Additional information:

Human resources: To be performed correctly, lethal injections must be conducted by highly specialized personnel - i.e. veterinarians with, ideally, expertise in poultry species. These professionals are often in limited supply, which can present logistical challenges during large-scale depopulation events. In situations where the necessary human resources are unavailable, prioritization to duck farms should be considered due to the heightened potential of ducks to facilitate viral spread.

Administration route: Lethal injection is a preferred depopulation method regarding poultry welfare when the euthanizing drug is administered either via the occipital sinus or intravenously. Any other route of administration (e.g., in intramuscular) should not be used to avoid any unnecessary suffering of the birds. Practically-speaking, intravenous injections may only be feasible when small flocks (< 1000 birds) are to be depopulated, intravenous injections being slower to perform than injections in the occipital sinus.

Poultry characteristics: Lethal injections can be applied to all types of poultry, but the efficiency of the process (killing throughput) is significantly influenced by the mobility and size of the animals. For instance, floor-reared broilers are more challenging to catch compared to ducks housed in cages, which can slow down operations. Additionally, the size of the birds plays a critical role; smaller animals present greater challenges in locating veins and sinuses, requiring more precision and concentration from the operator. These factors collectively affect the overall speed and practicality of using lethal injections across different poultry types.

1.3 Decision tree n° 3: Whole-house gassing



The green arrows in the decision tree indicate progression to the next question to be answered, while the red arrows signify that an alternative method must be considered.

Additional information about the method:

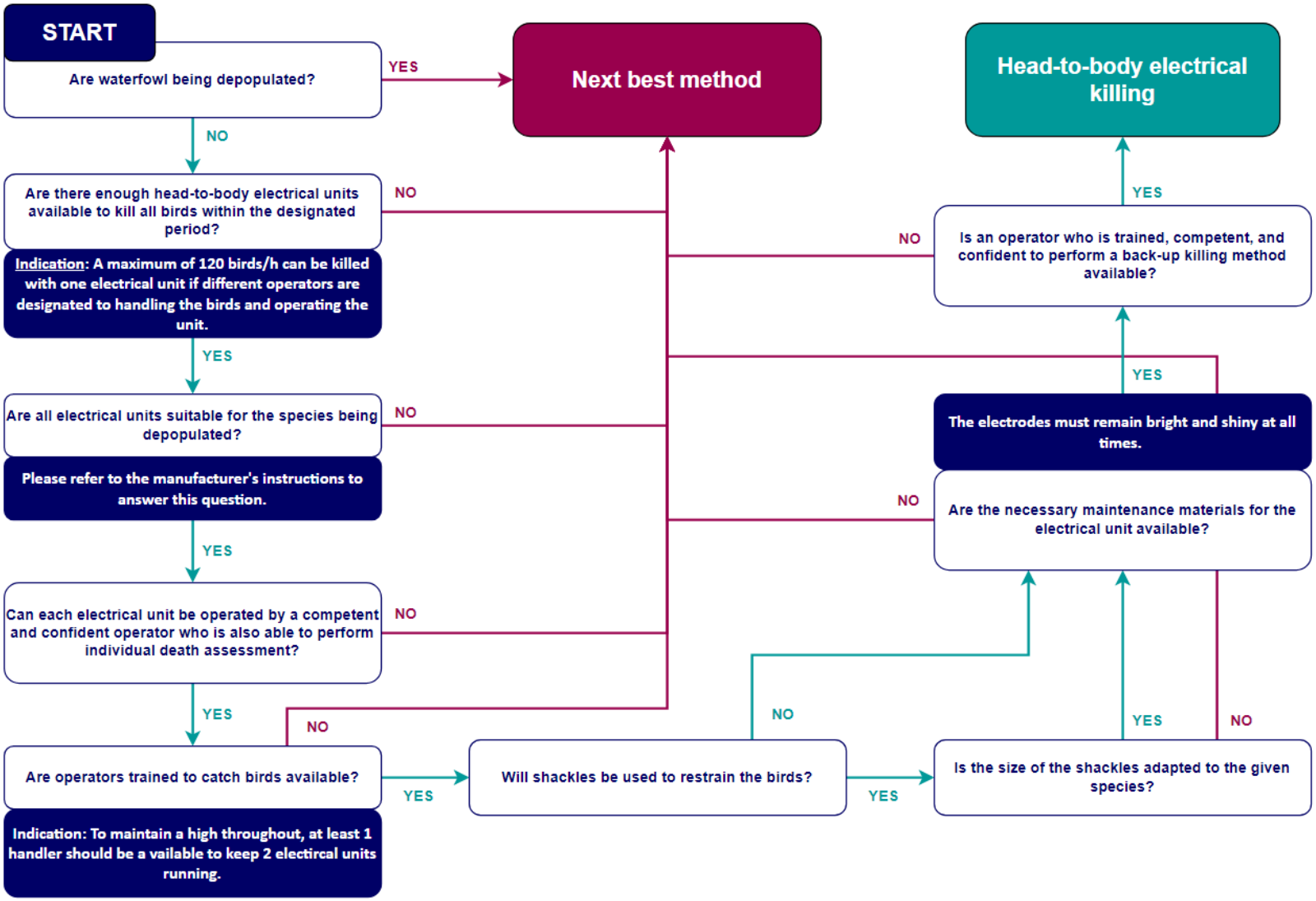
Gas monitoring: Whole-house gassing (WHG) can be applied effectively across various types of indoor housing systems (e.g., floor or multi-tier systems). However, the complexity of the barn's interior design directly impacts the monitoring requirements for gas concentrations. More sensors are necessary in barns with intricate layouts to ensure that the target gas concentrations are achieved uniformly throughout the space. This is essential to ensure that all animals, regardless of their location within the barn, are exposed to the appropriate levels of gas.

Sealability of the house: CO_2 gassing requires that the openings of the building are adequately sealed to contain the gas and maintain the required concentration levels. However, complete sealing should be avoided to prevent overpressure and to allow to escape through the upper parts of the building. This is particularly important because CO_2, being heavier than O_2, settles at lower levels, thus displacing O_2 upward. If N_2 is used for gassing, the building must be more effectively sealed, as achieving the low O_2 concentrations required (e.g., 2%) is more challenging. Additionally, N_2 is more volatile than CO_2, making it more susceptible to displacement by wind drafts in the presence of leakages.

Environmental conditions: Under high-temperature conditions, careful consideration must be given to the timing of ventilation shutdown to prevent hyperthermia in the animals.

Protective measures against freezing: Measures must be implemented to prevent any direct contact between the gas and the birds, as this could result in severe injuries such as freezing or cold burns. Such measures include, for instance, the chamfering of high-pressure inlets and the installation of fences around the injection points to prevent birds from approaching them.

1.4 Decision tree n°4: Head-to-body electrical killing



The green arrows in the decision tree indicate progression to the next question to be answered, while the red arrows signify that an alternative method must be considered.

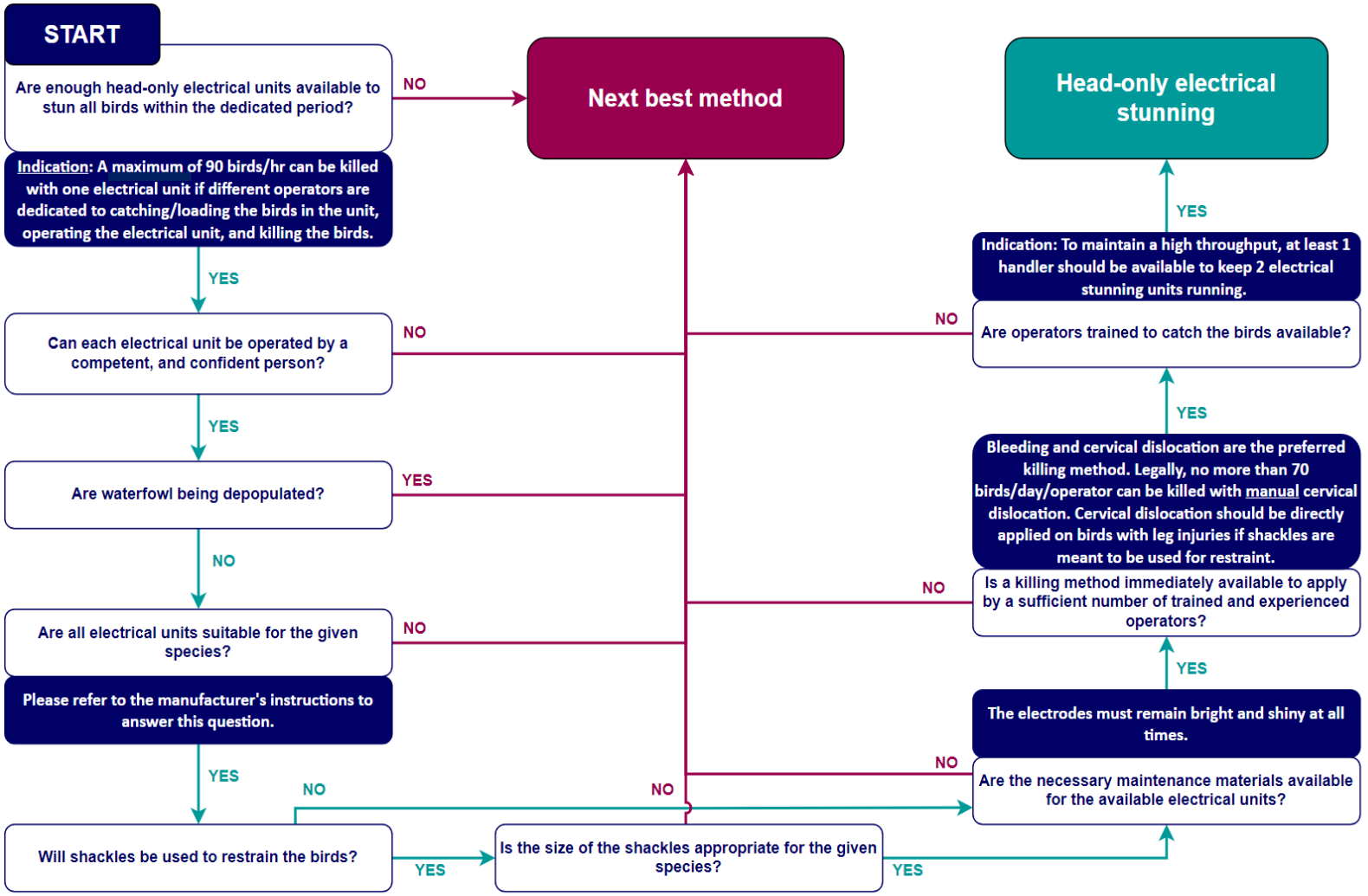
Additional information:

Poultry characteristics: Head-to-body electrical stunning units have not been tested on waterfowls, so their efficacy and impact on these species are currently unknown. As a precaution, this method should not be used on waterfowls until further studies demonstrate that it is both effective and meets welfare standards.

Electrode maintenance: Electrodes must be kept clean and "bright and shiny" to avoid increased impedance, heating, or grease accumulation. Routine inspection and cleaning between birds are critical.

Electrical current path: Birds should remain dry to prevent current from traveling through water instead of the brain. Electrodes must remain wet to ensure proper current flow.

1.5 Decision tree n°5: Head-only electrical stunning followed by a killing method



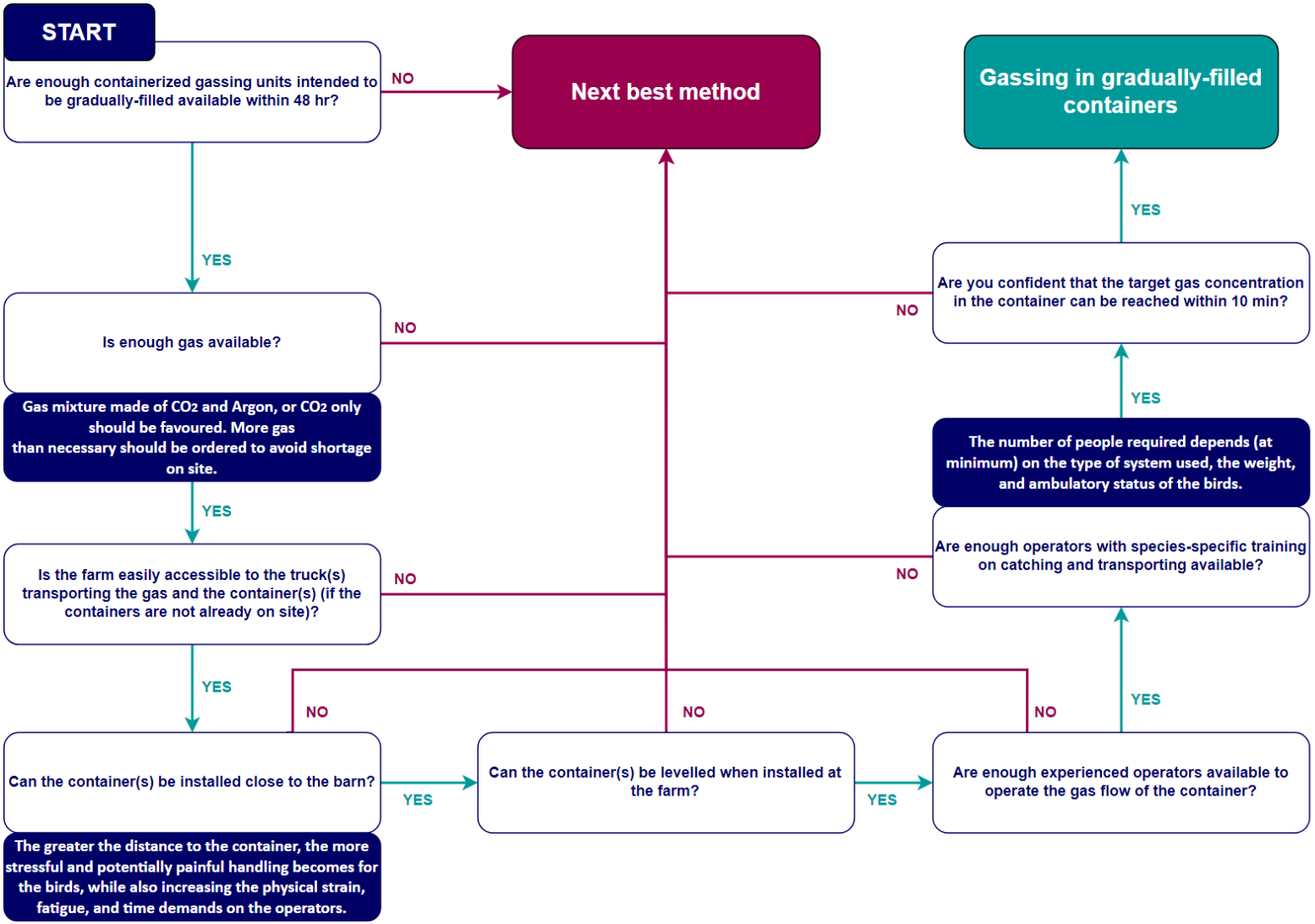
The green arrows in the decision tree indicate progression to the next question to be answered, while the red arrows signify that an alternative method must be considered.

Additional information:

Poultry characteristics: Head-only electrical stunning units have not been tested on waterfowls, so their efficacy and impact on these species are currently unknown. As a precaution, this method should not be used on waterfowls until further studies demonstrate that it is both effective and meets welfare standards.

Stun-to-kill interval: The killing method following the stunning should be immediately available to apply, to avoid consciousness recovery from birds. Bleeding could be considered when birds are held in a cone, as it does not require the birds to be removed from the cone to be applied.

1.6 Decision tree n°6: Gassing in gradually-filled containers



The green arrows in the decision tree indicate progression to the next question to be answered, while the red arrows signify that an alternative method must be considered.

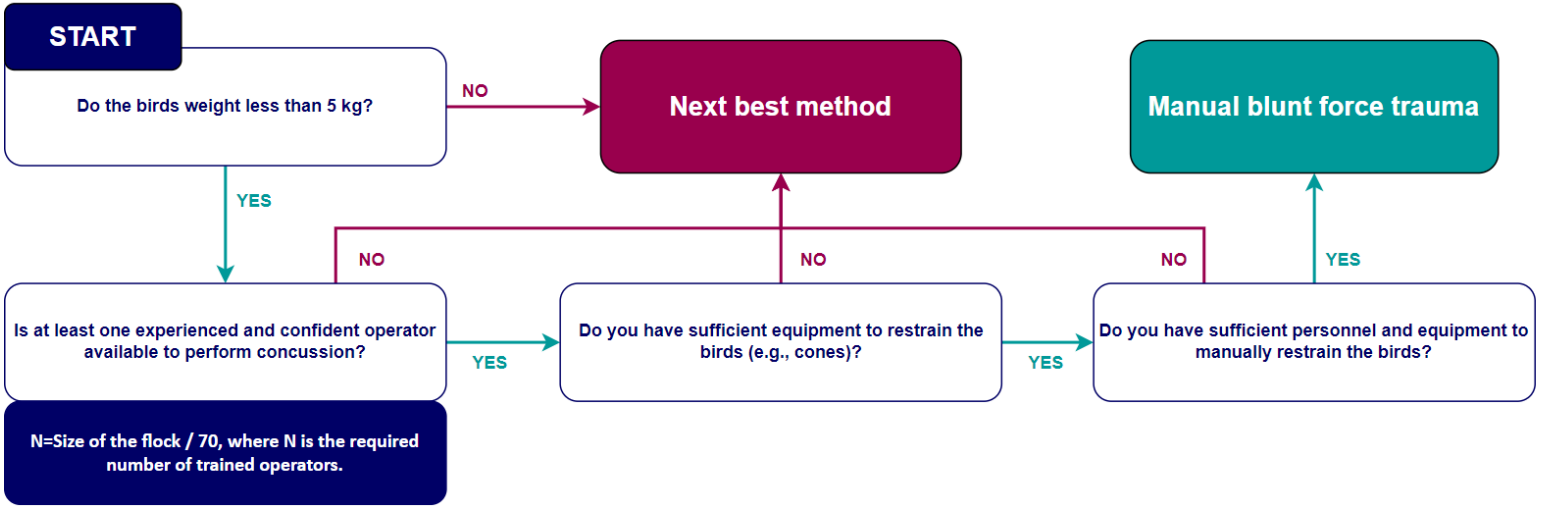
Additional information:

Poultry characteristics: For ambulatory birds, especially heavy ones, consider using cages to transport the birds from the house to the container. Birds can walk themselves to these cages (rather than being manually transported by the operators), and the cages can thereafter be lifted with a forklift and brought close to the container.

Set-up of the container: The container must be placed on a level surface, such as a concrete floor, to ensure that the doors remain properly aligned and sealed, preventing gas leaks.

Transport of birds: If the container cannot be installed close to the barn, consider transporting the birds to the container in trolleys to reduce handling stress and operator's fatigue.

1.7 Decision tree n°7: Manual blunt force trauma



The green arrows in the decision tree indicate progression to the next question to be answered, while the red arrows signify that an alternative method must be considered.

Additional information:

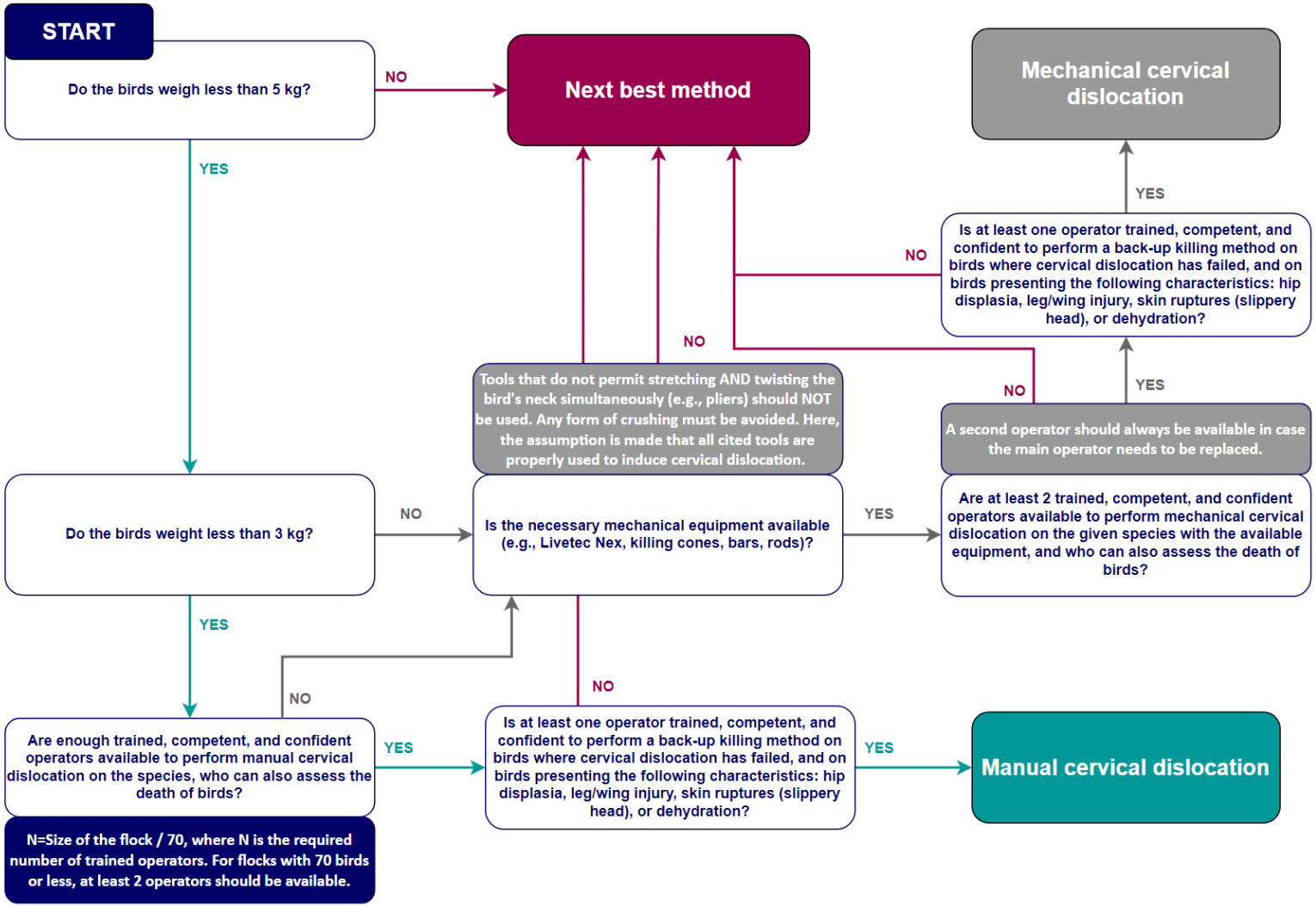
Efficacy of the method: In theory, manual blunt force trauma is very effective when performed correctly by confident and experienced operators. In practice, however, there are few options for formal training of the operators and the effectiveness of the method varies greatly between operators on field.

Context of application: The use of manual blunt force trauma should only be considered: 1) in emergency situations where it allows compromised or moribund birds to be euthanized faster than with other methods, 2) for small-scale depopulation (i.e., for flocks with less than a thousand birds) and 3) as a secondary method following a simple stunning method or an inefficient killing method.

Administration of the blow: The method of administering a blow to induce concussion in poultry varies depending on factors such as the bird's size and position. Smaller birds, such as young chickens, can be handled manually by swinging their head against a hard object, whereas larger birds, like turkeys, typically require the use of specialized tools such as hammers, priests, or bars to ensure an effective impact. Non-ambulatory birds, which remain stationary on the ground, and birds restrained in a vertical position offer an opportunity for a controlled downward strike aimed at the back of the head. Conversely, birds with their heads placed on a hard surface are best struck on the top of the head or crown, between the eyes and ears, mimicking the application of a captive bolt stunner for precision and effectiveness.

Research gaps: Key areas requiring further investigation include the optimal mass and velocity of tools to ensure consistent and effective stunning across bird sizes, as well as the impact of bird-specific characteristics, such as comb structure, on efficacy. Additionally, there is limited data on the most effective training protocols for operators and the welfare implications of various positioning and restraint techniques. Addressing these gaps would improve the reliability of this method and ensure compliance with welfare standards.

1.8 Decision tree n°8: Cervical dislocation



The green arrows in the decision tree indicate progression to the next question to be answered, while the red arrows signify that an alternative method must be considered.

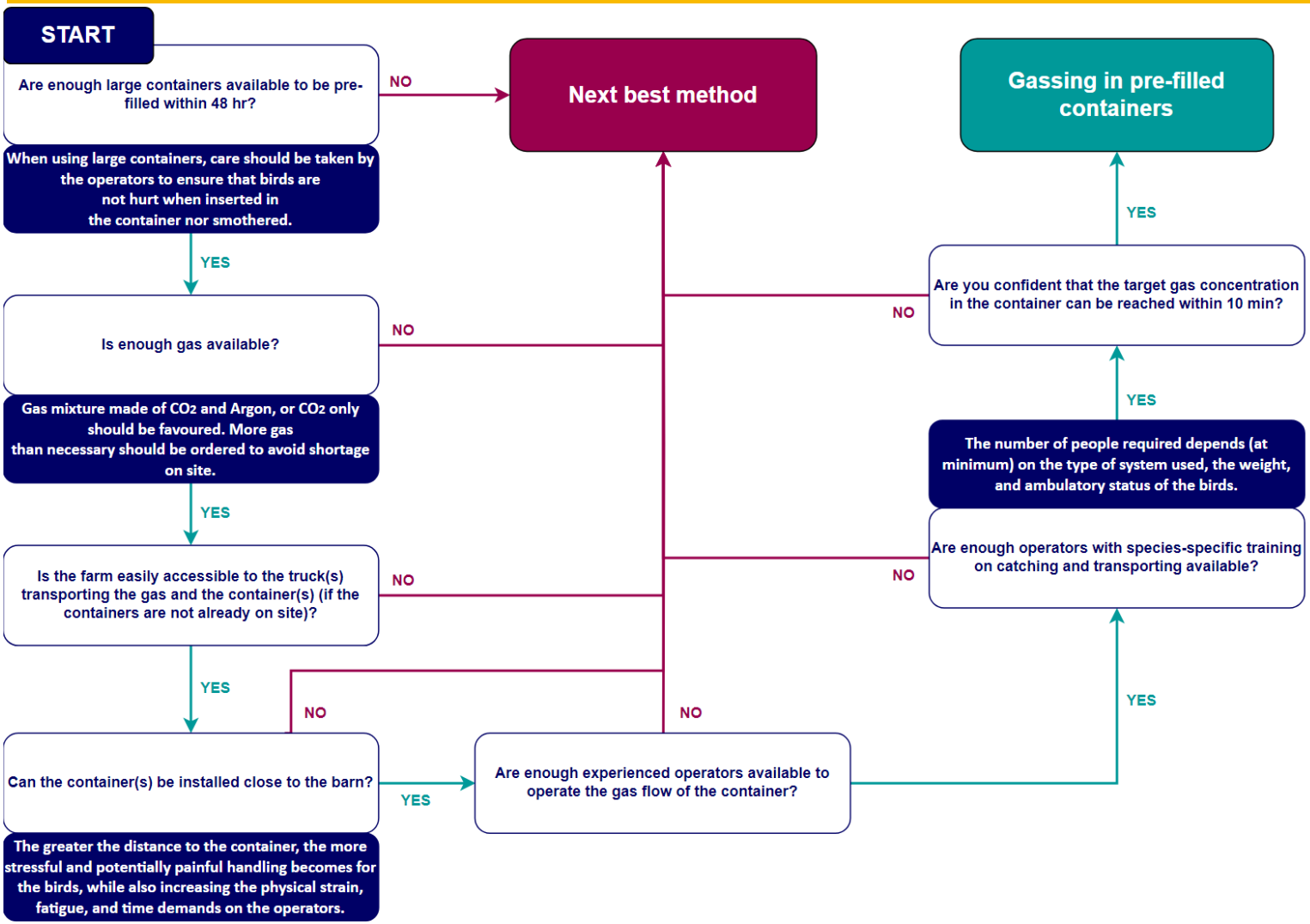
Additional information:

Context of application: The use of cervical dislocation should only be considered: 1) in emergency situations where it allows compromised or moribund birds to be euthanized faster than with other methods, 2) for small-scale depopulation (i.e., for flocks with less than a thousand birds) and 3) as a secondary method following a simple stunning method or an ineffective killing method.

Operator training: Species-specific training is crucial for operators performing cervical dislocation to address the unique anatomical and physiological characteristics of different poultry species. For instance, mature birds such as laying hens often present challenges due to osteoporosis and dense connective tissue, which require careful consideration to ensure the dislocation is performed effectively. Similarly, adjustments in technique, such as modifying hand positioning, are necessary for birds with large combs to avoid interference and ensure proper application.

Research gaps: Limited data exist regarding the effectiveness and operator performance beyond small-scale setting, i.e. for medium and large flocks. In line with current EU legislation and in the absence of scientific evidence demonstrating that operators can maintain consistent performance with larger numbers of birds, the method should therefore be reserved for small flocks. The physical impacts - and welfare consequences thereof – of cervical dislocation on birds (e.g., its effects on the skeletal and muscular structures in terms of fractures patterns) remain also poorly understood. More research should also be conducted to refine the current techniques used to perform cervical dislocation on chicks and ensure a proper application (i.e., simultaneous stretching and twisting of the neck and not crushing).

1.9 Decision tree n°9: Gassing in pre-filled containers



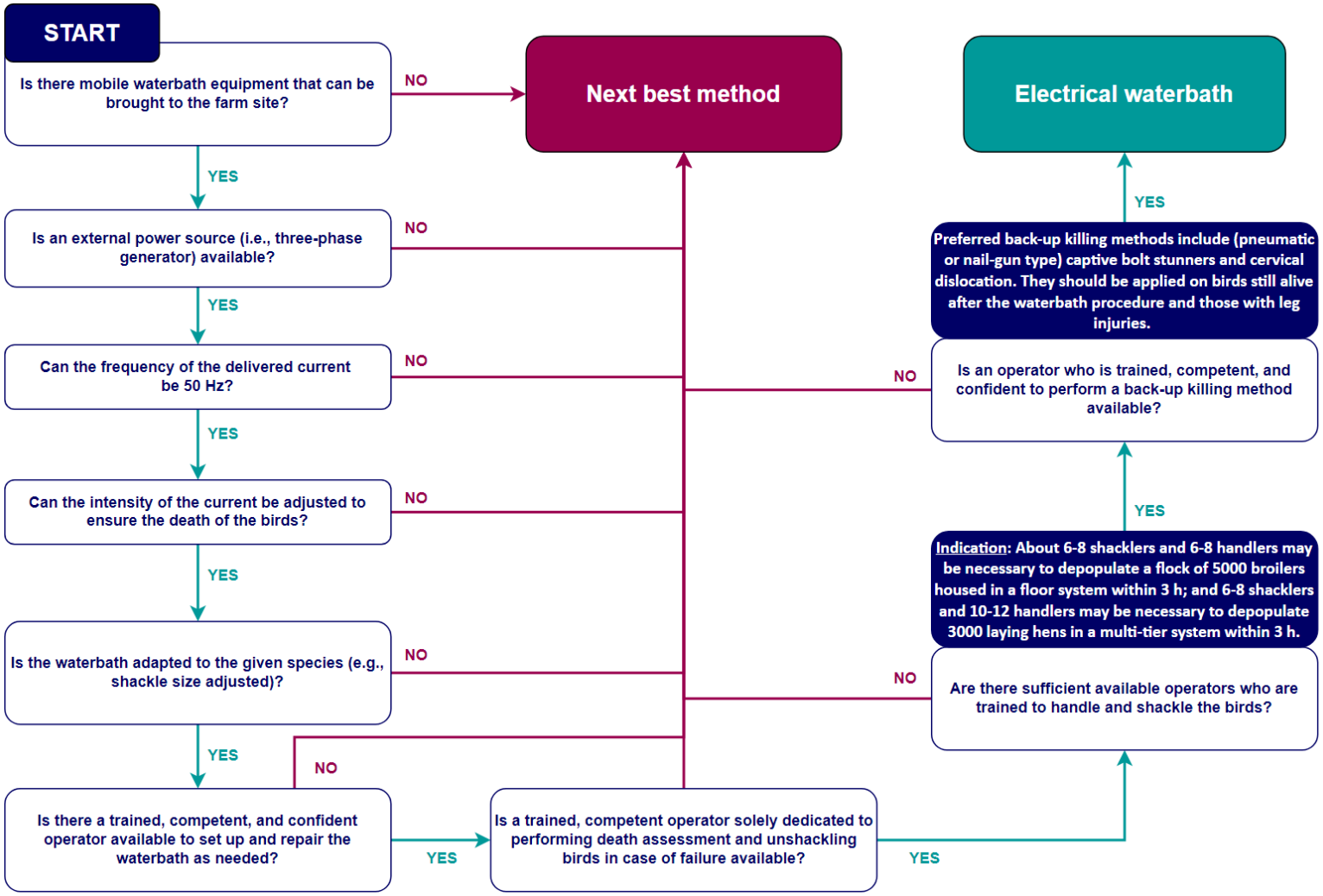
The green arrows in the decision tree indicate progression to the next question to be answered, while the red arrows signify that an alternative method must be considered.

Additional information:

Poultry characteristics: For ambulatory birds, especially heavy ones, consider using cages to transport the birds from the house to the container. Birds can walk themselves to these cages (rather than being manually transported by the operators), and the cages can thereafter be lifted with a forklift and brought close to the container.

Transport of birds: If the container cannot be installed close to the barn, consider transporting the birds to the container in trolleys to reduce handling stress and operator's fatigue.

1.10 Decision tree n°10: Electrical waterbath



The green arrows in the decision tree indicate progression to the next question to be answered, while the red arrows signify that an alternative method must be consider

Additional information:

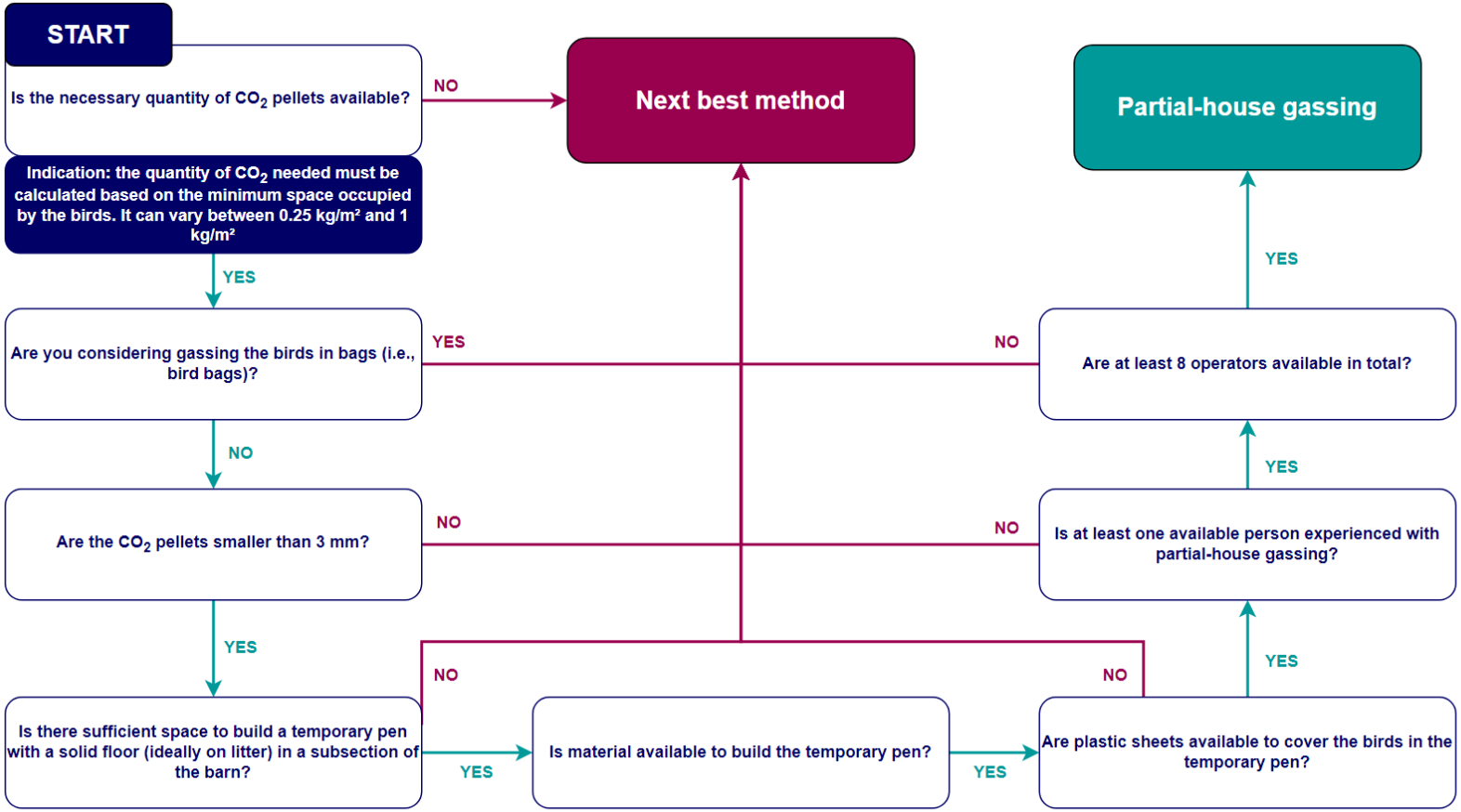
Power supply: The operation of a mobile electrical water bath necessitates a reliable power supply, which can be unavailable on farms. To avoid delays, it is essential to anticipate the need for a three-phase generator in advance. Renting a generator at the last moment can result in significant setbacks, as it typically takes three to four days for delivery. Owning a suitable generator is strongly recommended to ensure timely operations

Electrical parameters: To achieve cardiac arrest and death in birds, the electrical frequency should be set at 50 Hz, and the waterbath system must be capable of delivering voltages higher than those typically used in slaughterhouses (e.g., up to 230 V). An ideal system would deliver a constant current to every bird. This would ensure that each bird receives the proper electrical current to induce death.

Poultry characteristics: The design of the electrical waterbath system must be tailored to the specific type of poultry being processed to ensure its effectiveness. For example, shackles must be appropriately sized to securely hold the birds, while additional measures should be implemented to prevent species such as waterfowl from lifting their heads out of the water, which could result in incomplete or ineffective stunning.

Human resources: Operators with different set of skills are required to fulfil various roles. Personnel is needed to catch, transport and load the birds onto the shackle line, as well as to operate the electrical system and make the necessary repairs to the equipment as needed. Operators should also be available to confirm the effective death of each individual, and immediately perform a back-up killing method in case of need. Incorporating a contingency of approximately 10% additional personnel beyond the baseline requirements is recommended. This surplus allows for effective task rotation and mitigates disruptions arising from factors such as worker fatigue, scheduled breaks, or unforeseen injuries. Such staffing strategies enhance operational resilience and maintain workflow efficiency under variable conditions.

1.11 Non-ranked decision tree: Partial house gassing



The green arrows in the decision tree indicate progression to the next question to be answered, while the red arrows signify that an alternative method must be considered.

Additional information:

Housing systems: Current experience with partial-house gassing is limited to litter-based system. Implementing partial-house gassing to cage, multi-tier, or slatted-floor systems would demand further testing to evaluate its efficacy and feasibility. Poultry housed under such systems would probably need to be relocated to a solid floor area – rendering the process less practical.

Poultry characteristics: Partial-house gassing has been reported to be successfully used on various species, such as broilers breeders, broilers and ducks. However, specific precautions are necessary when using this method for turkeys since they have a natural tendency to climb onto each other. This behaviour increases the risk of injuries, suffocation, and uneven exposure to the gas. To mitigate these risks, experts recommend limiting the number of turkeys treated in a batch (e.g.50 turkeys of 20kg).

Gas monitoring: Adjusting CO_2 levels during the process is challenging, as covered areas cannot be opened mid-process without compromising the method's efficacy. Calculations and preparation must be meticulous to achieve target concentrations. In the future, remote-readable sensors could be employed to monitor CO_2 levels during the procedure and solutions should be developed to allow adjustment in CO_2 pellets quantities if deficiencies are detected.

Gassing technique: Poultry should not be gassed in large bags. Gassing in bags is associated with sublimation inefficiencies, leading to insufficient gas concentrations in certain areas of the bags. As a result, several birds may survive the procedure, even after prolonged exposure to the gas.

Diameter of the pellets: Pellets must be small enough (< 3 mm diameter from expert knowledge) for the CO_2 to effectively sublimate.

Human resources: Partial-house gassing requires a team of approximately eight operators for effective execution. Two individuals are responsible for distributing dry ice across the pen. Managing the plastic cover sheet involves four people: two to position the sheet over the birds after the dry ice is applied and two to secure it tightly to the ground, preventing any gas leakage. Additionally, two experienced operators oversee the entire process, ensuring accurate execution and adherence to protocols.

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About EURCAW-Poultry-SFA

EURCAW-Poultry-SFA is one of the four European Union Reference Centres for Animal Welfare. It focuses on poultry and other small farmed animals welfare and legislation, and covers the entire life cycle from hatch/birth to the end of life. EURCAW-Poultry-SFA's main objective is to scientifically and technically support the European Commission and Member States for implementation of welfare legislation. This includes:

- Directive 98/58/EC concerning the protection of animals kept on farms;
- Regulations 1/2005/EC and 1099/2009/EC concerning their protection during transport and slaughter;
- Directive 1999/74/EC laying down minimum standards for the protection of laying hens;
- Directive 2007/43/EC laying down minimum rules for the protection of chickens kept for meat production.

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- Coordinated Assistance
  Providing support, networking and Questions to EURCAW;
- Welfare indicators, Assessment & Good Practices
  Identifying animal welfare indicators, including animal based, management based and resource-based indicators, that can be used to verify compliance with the EU legislation;
- Scientific and technical studies
  Preparing Scientific Reviews of knowledge on welfare topics, identify research needs and perform scientific and technical studies to fill the gaps of knowledge;
- Training
  Reviewing existing training activities and developing new training materials, webinars and knowledge pills for official inspectors and competent authorities;
- Communication and Dissemination
  Increasing awareness of our outputs via the website, and newsletter.

Website and contact

EURCAW-Poultry-SFA's website offers relevant and actual information to support enforcement of poultry and other small farmed animals' welfare legislation.

We offer a 'Questions to EURCAW' service for official inspectors, policy workers, and other personnel providing advice or support for official controls of poultry and other small farmed animals welfare in the EU. For more information go to the Q2E webform available online here or https://survey.anses.fr/SurveyServer/s/DSL/Queryw. All Q2E answers are available online

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