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EU FP6 Welfare Quality® Poultry Assessment Systems[1]

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ABSTRACT Animal welfare is of considerable importance to European consumers and citizens, this being most recently confirmed in EU barometer studies. Researchers and others have long proposed that animal-based measures (measures taken on animals, e.g. their health and behaviour) can provide a valid indicator of animal welfare; since welfare is a characteristic of the individual animal. Therefore, a welfare assessment can be essentially based on animal-based measures, but with use of resource measures to provide the capacity to assess 'risk factors'. The first goal of this project was to develop a welfare monitoring system that enables assessment of welfare status through standardised conversion of welfare measures into accessible and understandable information. The acquired information on one hand provides feedback to animal unit managers about the welfare status of their animals, and on the other, information on the welfare status of animal-related products for consumers and retailers. The second goal of Welfare Quality® was to improve animal welfare by minimising the occurrence of harmful behavioural and physiological states, improving human-animal relationships, and providing animals with safe and stimulating environments. The different measurable aspects of welfare to be covered are turned into welfare criteria. The criteria reflect what is meaningful to animals as understood by animal welfare science. Once all the measures have been performed on an animal unit, a bottom-up approach is followed to produce an overall assessment of animal welfare on that particular unit: first the data collected (i.e. values obtained for the different measures on the animal unit) are combined to calculate criterion-scores; then criterion-scores are combined to calculate principle-scores; and finally the animal unit is assigned to a welfare category according to the principle-scores it obtained.
(Key words : animal welfare, broiler chicken, assessment, welfare measures, welfare scoring, labelling)

INTRODUCTION

Animal welfare is of considerable importance to European consumers and citizens this being most recently confirmed in EU barometers (EC, 2005). Consumers expect their animal-related products, especially food, to be produced with respect for the welfare of the animals (Kjarnes and Larvik, 2007).

Researchers and others have long proposed that animal-based measures (measures taken on animals, e.g. their health and behaviour) can provide the most valid indicators of animal welfare; since welfare is a characteristic of the individual animal Main et al., 2003, Spoolder et al., 2003). Therefore, a welfare assessment would best be essentially based on animal-based measures. It is however clear that resource and management-based measures can be used to identify risks to animal welfare (i.e. risk factors used to help diagnose causes of poor welfare), but should contribute to a welfare assessment only if they are closely correlated to animal-based measures.

The trends in society and animal welfare science were combined in a successful application for an Integrated Project within the 6th EU programme called Welfare Quality® (WQ). The first goal of this project was to develop a welfare monitoring system that enables assessment of welfare status through standardised conversion of welfare measures into accessible and understandable information. The acquired information on one hand provides feedback to animal unit managers about the welfare status of their animals, and on the other, information on the welfare status of animal-related products for consumers and retailers. The second goal of Welfare Quality® was to improve animal welfare by minimizing the occurrence of harmful behavioural and physiological states, improving human-animal relationships, and providing animals with safe and stimulating environments.

One specific aim was to develop an integrated, standardized, and wherever possible animal-based methodology for the assessment of welfare, the Welfare Quality® protocols (Veissier et al., 2008). The chosen animal species, based on their economic and numeric importance, are pigs, poultry and cattle. In addition, the focus has been on the production period of the animals' life (i.e.

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on farm/transport/slaughter). During development of the welfare assessment it was decided that a common approach across animal species should be used as much as possible.

The protocol comprises a description of each of the measures to be carried out by the assessor, followed by a table in which the sampling order, sample sizes and sample duration is presented (i.e. 'collection of data' paragraphs). The scoring scheme can also be used to provide feedback to the animal unit manager or for other parties, such as consumers or retailers (Botreau et al., 2007). The way the measures are integrated and combined to provide this scoring information is described in the evaluation and information protocol part of the document (i.e. 'calculation of scores' paragraphs). Welfare Quality® has developed an assessment system to enable overall assessment of welfare and the standardised conversion of welfare measures into summary information.

The welfare assessment related to a specific animal unit (Fig. 1) is based on the calculation of welfare scores from the information collected on that unit. An advisor can use the welfare assessment to highlight points requiring the animal unit managers' attention. The information can also be used to inform consumers about the welfare status of animal products.

The protocol address animals at different stages of their lives and/or in various housing systems. It can cover the rearing and production period on farm and the period at the end of life of the animal, which includes transport and slaughter. At the moment there are no measures which are carried out during the actual transport process, but the effects of transport on welfare can be determined by examining the animals on arrival at the slaughterhouse. Transport measures may be added in the future.

Whenever possible animal-based measures (i.e. measures taken at animal level) are used. Only if no animal based measures are available, resource- and management-based measures are used (see Fig. 2).

The different measurable aspects of welfare to be covered are turned into welfare criteria. The criteria reflect what is meaningful to animals as understood by animal welfare science (Webster, 1997). They are also to be agreed by stakeholders in order to ensure that wider ethical and sociological issues have been dealt with, and furthermore to maximize the likelihood of successful translation into practice.

Because there is no 'gold standard' measure of overall animal welfare (Dawkins, 1990) and no available information on the relative importance animals attribute to the various welfare aspects, the interpretation of measures in terms of animal welfare and their integration into criteria, principles, and overall assessment of welfare relies on expert opinion on what counts for animals, and what society finds acceptable/unacceptable.

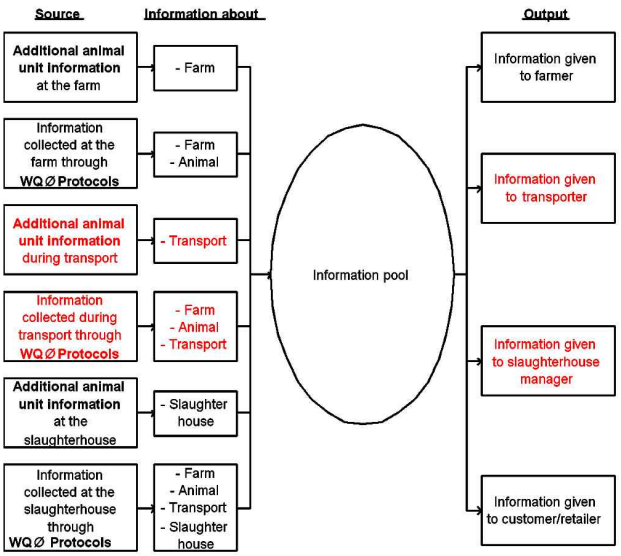

Fig. 1. The different sources of information in Welfare Quality®. The red text represents protocol aspects that are not separately included at the moment.

DEFINING WELFARE PRINCIPLES AND CRITERIA

Each welfare principle is phrased in such a way that it easily

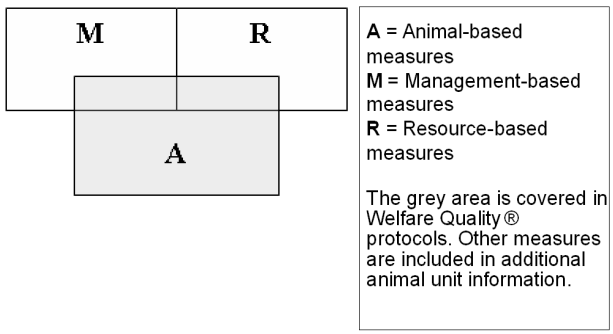

Fig. 2. Basis of Welfare Quality® measures.

communicates a key welfare question in society. Four main principles are identified: good feeding, good housing, good health, appropriate behaviour. They correspond to the questions:

- Are the animals properly fed and supplied with water?
- Are the animals properly housed?
- Are the animals healthy?
- Does the behaviour of the animals reflect optimized emotional states?

A principle is a collection of criteria. Each criterion represents a separate aspect of animal welfare. To define what the conditions for good or poor welfare are, certain desirable conditions must be at hand with which the actual on-farm situation can be compared. Therefore the Welfare Quality® criteria consider the following guidelines:

- Welfare criteria should be applicable to all farm animal species.
- Criteria should be grouped according to how they are experienced by the animals. For instance, poor resting areas may lead to abnormal behaviours and to injuries, with the former resulting in discomfort and the latter in pain. Hence, these two aspects are considered separately. In contrast, injuries, whatever their cause, are grouped together because they all have the potential to result in pain.
- Trade-offs within a given criteria may be allowed but should be limited between items. For example, good human-animal relationships do not compensate for a lack of social contact between animals (Raussi et al., 2003).

Each principle comprises two to four criteria. Criteria are independent of each other and form an exhaustive but minimal list. As a result of this process, twelve welfare criteria were identified; these were subsequently grouped into four main principles to ease their aggregation within the overall assessment. A top-down approach is followed to decide on what measures are needed to check these welfare criteria. In general, these criteria are valid throughout an animal's entire lifespan. Welfare principles and criteria are summarized in Table 1.

More detailed definitions of welfare criteria are described below.

Table 1. The principles and criteria that are a basis for the Welfare Quality® protocols

Welfare principles		Welfare criteria
Good feeding	1	Absence of prolonged hunger
	2	Absence of prolonged thirst
Good housing	3	Comfort around resting
	4	Thermal comfort
	5	Ease of movement
Good health	6	Absence of injuries
	7	Absence of disease
	8	Absence of pain induced by management procedures
Appropriate behaviour	9	Expression of social behaviours
	10	Expression of other behaviours
	11	Good human-animal relationship
	12	Absence of fearfulness

1. Animals should not suffer from prolonged hunger, i.e. they should have a sufficient and appropriate diet.
2. Animals should not suffer from prolonged thirst, i.e. they should have a sufficient and accessible water supply.
3. Animals should have comfort around resting.
4. Animals should have thermal comfort, i.e. they should neither be too hot nor too cold.
5. Animals should have enough space to be able to move around freely.
6. Animals should be free of physical injuries.
7. Animals should be free of disease, i.e. animal unit managers should maintain high standards of hygiene and care.
8. Animals should not suffer pain induced by inappropriate management, handling, slaughter, or surgical procedures (e.g. castration, dehorning).
9. Animals should be able to express normal, non-harmful, social behaviours (e.g. grooming).
10. Animals should be able to express other normal behaviours, i.e. it should be possible to express species-specific natural behaviours such as foraging.
11. Animals should be handled well in all situations, i.e. handlers should promote good human-animal relationships.

12. Negative emotions such as fear, distress, frustration or apathy should be avoided.

MEASURES DEVELOPED TO CHECK CRITERIA

Whenever possible, the final Welfare Quality® assessment measures have been evaluated with respect to their validity (does the measure reflect some aspect of the actual welfare of animals), repeatability (acceptable inter or intra observer repeatability and robustness to external factors e.g. time of day or weather conditions) and their feasibility. A further important aspect of this data collection is that value judgments are minimized, i.e. the assessor counts or classifies animals according to a simple series of categories illustrated by pictures or video clips. Hence measures in the protocols do not require veterinary diagnostic expertise or specialist animal behavioural knowledge to accurately record.

Once all the measures have been performed on an animal unit, a bottom-up approach is followed to produce an overall assessment of animal welfare on that particular unit (Fig. 3): first the data collected (i.e. values obtained for the different measures on the animal unit) are combined to calculate criterion-scores; then criterion-scores are combined to calculate principle-scores; and finally the animal unit is assigned to one welfare category according to the principle-scores it obtained (see Table 2 and Fig. 4). A mathematical model has been designed to produce the overall assessment.

Welfare Quality® scientists are aware that the production of an overall assessment of animal welfare is by nature bound to ethical decisions, e.g. on whether we should consider the average state of animals vs. the worst ones, whether we should consider each welfare criteria separately vs. together in a more holistic approach, or whether a balance between societal aspirations for high welfare levels and the realistic achievements of such levels in practice should be achieved. Welfare Quality®

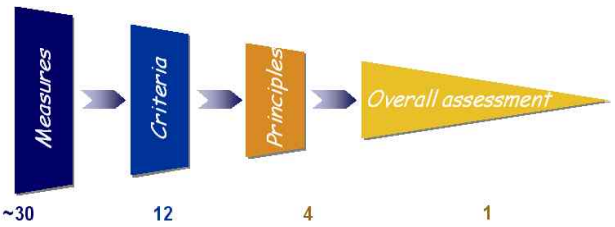

Fig. 3. Bottom-up approach for integrating the data on the different measures to an overall assessment of the animal unit.

Table 2. Example of an individual measure

Title	Foot pad dermatitis
Scope	Animal-based measure: Broiler chicken at slaughter
Method description	· Foot pad dermatitis (or pododermatitis) is a contact dermatitis found on the skin of the foot, most commonly on the central pad, but sometimes also on the toes. The skin is turned dark by contact with litter and consequently deep skin lesions can result. The scoring scale allows an assessment of the severity of these lesions. · During three separate recording periods of five minutes, score a proportion of the birds passing the observation point where the foot pad is visible - this will provide a sample of n (line speed birds per minute (ls) x number of minutes (t)). Observe the birds where bottom of the feet are clearly visible. Record number of birds passing per minute. Count number of birds with foot pad lesions (b/c/d/e) - use scoring category in photographic reference. In the MEYN camera system, three scores are reported - 0 (as 0 below), 1 (as 1 below) 2 (combining all score of 2 and above - 2, 2+ and 2++) · To classify use calculation below, in which t = period of observation (minutes), F a/b/c/d/e = number of birds with foot pad lesion, ls = line speed (birds per minute) and n = number of birds observed in total (t × ls). Percentage of birds with foot pad lesions in each category = (F(0), F(1) etc../n) × 100%
Classification	Individual level Percentage of birds with foot pad lesions in each category.

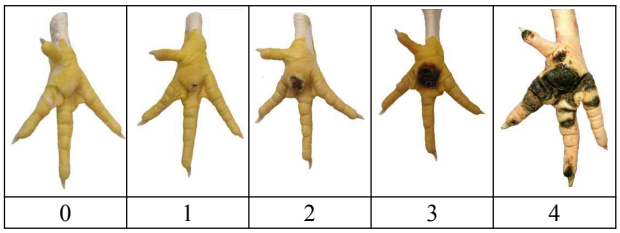

Fig. 4. Scale for manual (visual observation).

scientists did not sort these ethical issues themselves. They consulted a number of experts, including animal scientists, social scientists, and stakeholders and the mathematical model was then fine tuned according to their opinions.

CALCULATION OF CRITERION-SCORES

Experts from animal sciences were consulted to interpret the raw data in terms of welfare. When necessary, alarm thresholds and the relative importance of the different measures were defined with them. Then experts were asked to score virtual datasets. In case weighted sums were to be calculated, this consultation was used to define weights that produce the same ranking of farms as the one given by experts.

The experts never followed a linear reasoning, e.g. for a given anomaly a 10 % increase in that anomaly did not yield the same increment in expert scores at the bottom of the [0,100] scale (where most animals were already not normal) than at the top of the scale (when all animals were normal). It was therefore necessary to resort to non-linear functions to produce criterion-scores, in this case I-spline functions. I-spline functions allow calculation of portions of curves so as to obtain a resulting smooth increasing curve. They are expressed in the form of cubic functions.

The % birds moderately affected by foot pad dermatitis (% pododermatitis 1) and the % birds severely affected by foot pad dermatitis (% pododermatitis 2) are used to calculate an index:

Ip is turned into a score Sp using I-spline functions

When $Ip \leq 70$ then $Sp = (0.50686 \times Ip) - (0.0072409 \times Ip2) + (0.000081315 \times Ip3)$

When $Ip \geq 70$ then $Sp = -513.33 + (22.507 \times Ip) - (0.32152 \times Ip2) + (0.0015779 \times Ip3)$

CALCULATION OF PRINCIPLE-SCORES FROM CRITERION-SCORES

Criterion-scores are synthesized to calculate principle-scores. For instance, the scores obtained by an animal unit for absence of hunger and absence of thirst are combined to reflect compliance of this unit with the principle 'good feeding'. Animal and social scientists were consulted. They considered some criteria more important than others (e.g. absence of thirst is considered to be more crucial than absence of hunger) but they nevertheless do not accept compensation between scores (e.g. absence of thirst does not compensate hunger and vice versa). A specific operator (Choquet integral) was used to take into account these two lines of reasoning. Briefly, the Choquet integral calculates the differences between minimum scores and the next ones and attribute a weight (called 'capacity') to this difference according to what sub criteria are concerned.

For instance, the principle-score for 'Good health' integrates the 3 criterion-score for 'Absence of injuries', 'Absence of disease', and 'Absence of pain due to management procedures'. First the scores are sorted in increasing order. The first score is considered, and then the difference between that score and the next one is multiplied by the capacity of the group made of all criteria except the one that brings the lowest score.

ASSIGNMENT OF ANIMAL UNITS TO THE WELFARE CATEGORIES

The scores obtained by an animal unit on all welfare principles are used to assign that farm to a welfare category. At that stage, animal scientists, social scientists, and stakeholders, were consulted. The stakeholders were members of the Advisory committee of Welfare Quality®. Four welfare categories are distinguished to meet stakeholders' requirements:

Aspiration values are defined for each category (Fig. 5). They represent the goal that the farm should try to achieve to be assigned to a given category. A farm is excellent if it scores more than 55 on all principles and more than 80 on two of them, it is enhanced if it scores more than 20 on all principles and more than 55 on two of them, it is basic if it scores more than 10 on all principles and more than 20 on three of them, else the farm is not classified (Fig. 5).

Excellent: the welfare of the animals is of the highest level. The animal unit may correspond to a niche market, via a label ensuring to consumers very high quality products (this label could be dedicated to animal welfare);
Enhanced: the welfare of animals is good (but not excellent). Good practices are applied and are sufficient to ensure a good level welfare within a more general quality labelling system.
Acceptable (or basic): the welfare of animals is acceptable (i.e. above minimal requirements defined for a compulsory label), but insufficient for the animal unit to enter a certification scheme based on specific 'respect for animal-welfare';
Not classified: the welfare of animals is low and considered unacceptable.

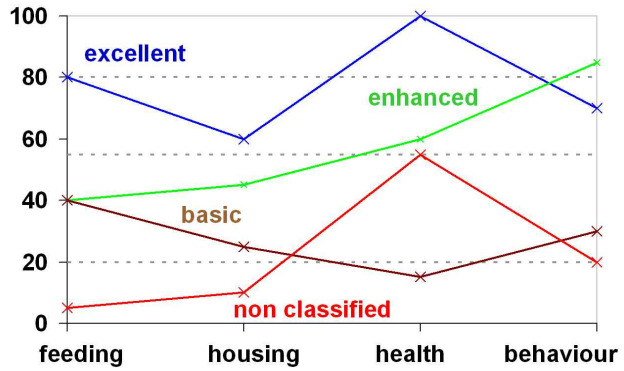

Fig. 5. Examples of farms in the four welfare categories.

Before commencing farm visits, assessors will have been fully trained in all the measures that are to be assessed using photographs, video clips and practical 'on farm' training. For some of the health measures, this training will involve recognition of symptoms of certain conditions/diseases; however it is imperative that this document is not used as a diagnostic tool to identify individual health conditions, but rather as a tool to highlight the presence of health problems affecting the welfare of animals. The assessor should not enter into discussions with the animal unit manager on the prevalence or severity of different diseases on their farm; this is a matter for the animal unit manager and the herd veterinarian (Butterworth et al., 2008). Additionally, in general, the role of the assessor is to assess, and is not to advise directly.

Trained assessors will use animal-based, management- based or resource-based measures to achieve a representative assessment of broiler chicken welfare of each farm. Many different measures are assessed, however many are scored according to a three-point scale ranging from 0~2. The assessment scales have been selected so that a score 0 is awarded where welfare is good, a score 1 is awarded (where applicable) where there has been some compromise on welfare, and a score 2 is awarded where welfare is poor and unacceptable. In some cases a binary (Yes/No, i.e. 0/2) or a continuous scale (e.g. cm or m^2) is used.

The measures made for broiler chickens are indicated in Tables 3, 4 and 5.

Table 3. Collection of data for broiler chicken on farm (measured on farm)

		Welfare criteria	Measures
Good feeding	1	Absence of prolonged hunger	No measure
	2	Absence of prolonged thirst	Drinker space
Good housing	3	Comfort around resting	Plumage cleanliness, litter quality, dust sheet test
	4	Thermal comfort	Panting, huddling
	5	Ease of movement	Stocking density
Good health	6	Absence of injuries	Lameness, hock burn, foot pad dermatitis
	7	Absence of disease	On farm mortality, culls on farm
	8	Absence of pain induced by management procedures	No measure
Appropriate behaviour	9	Expression of social behaviours	No measure
	10	Expression of other behaviours	Cover on the range, free range
	11	Good human-animal relationship	Avoidance distance test (ADT)
	12	Absence of fearfulness	Qualitative behavioural assessment (QBA)

Table 4. Collection of data for broiler chicken on farm (measured at slaughter). These measures are assessments of disease which are made at the slaughterhouse - but which reflect disease conditions indicating the farm life of the bird and are not reflections of the slaughter process.

		Welfare criteria	Measures
Good feeding	1	Absence of prolonged hunger	Emaciation
	2	Absence of prolonged thirst	No measure
Good housing	3	Comfort around resting	No measure
	4	Thermal comfort	No measure
	5	Ease of movement	No measure
Good health	6	Absence of injuries	Breast burns, hock burn, foot pad dermatitis
	7	Absence of disease	Ascites, dehydration, septicaemia, hepatitis, pericarditis, abscess
	8	Absence of pain induced by management procedures	No measure
Appropriate behaviour	9	Expression of social behaviours	No measure
	10	Expression of other behaviours	No measure
	11	Good human-animal relationship	No measure
	12	Absence of fearfulness	No measure

Table 5. Collection of data for broiler chicken at slaughterhouse

		Welfare criteria	Measures
Good feeding	1	Absence of prolonged hunger	Feed withdrawal time
	2	Absence of prolonged thirst	Water withdrawal time
Good housing	3	Comfort around resting	No measure
	4	Thermal comfort	Panting on lorry and/or lairage
	5	Ease of movement	Stocking density in crates
Good health	6	Absence of injuries	Wing damage, bruising
	7	Absence of disease	Dead on arrival (DOA)
	8	Absence of pain induced by management procedures	Pre-stun shock, effectiveness of stunning
Appropriate behaviour	9	Expression of social behaviours	No measure
	10	Expression of other behaviours	No measure
	11	Good human-animal relationship	No measure
	12	Absence of fearfulness	Flapping on the line

CONCLUDING REMARKS

Using the animal based measures proposed in the Welfare Quality® project, the farmer can be informed about the welfare measures on his farm, and, with time, and after analysis, a pattern of risk factors may emerge which allow the farmer to make specific management decisions which can reduce these. It may be possible to use the information gathered during the

inspection, or resulting from a 'rolling accumulation' of data on the farm, and provide this to retail purchasers and to consumers. The potential for differentiated product pricing or selection of 'upper level' producers by the purchasing teams working for retailers may offer the potential for increased income for farmers who work to a higher level. Ultimately, product differentiation may offer a route to both increased profitability and improved welfare against a background of an intensely competitive global farm economy.

적 요

동물복지는 유럽의 소비자들과 시민들에게 상당히 중요하다는 것이 최근의 여론조사에서 확인되었다. 동물복지는 개별동물의 특성이라는 것 때문에 연구자들 뿐만 아니라 다른 사람들도 동물에 근거한 평가기준 (동물에서 측정된 척도, 예를 들면, 동물의 건강과 행동)이 동물복지의 타당한 표식이 될 수 있다고 오래 동안 제안해왔다. 그러므로 복지의 평가기준은 필수적으로 동물을 사용한 평가 척도에 바탕을 둘 수 있으며, 반면에 자원을 근거로 한 평가 기준은 위해요소들을 평가할 수 있는 능력을 제공한다. 이 계획의 첫 번째 목표는 복지를 감시하는 체계를 개발하여 복지의 척도를 접근 가능하고 이해할 수 있는 정보로의 표준화된 변환을 통하여 복지의 상태를 평가할 수 있게 하는 것이다.

한편 얻어진 정보는 동물시설 관리자들에게 제공되어 동물복지의 상태에 대하여 알게 하며, 또 다른 한편으로는 소비자와 소매상에게 동물 관련 제품의 복지 상태에 대한 정보를 제공한다. 두 번째 목표는, 유해한 행동적 및 생리적인 사태의 발생을 최소화하고, 인간과 동물간의 관계를 향상시키며, 그리고 동물에게 안전하고 흥미로운 환경을 제공함으로써, 동물의 복지를 향상시키는 것이다. 포함되어야 할 복지에 대한 다른 측정 가능한 양상들은 복지의 표준들로 변환된다. 이들은, 동물복지과학으로 이해되는 것처럼, 동물에게 의미 있는 것을 반영한다. 일단 동물시설에 대한 모든 평가척도들이 측정되면, 그 시설물의 동물복지에 대한 전반적인 평가를 수행하기 위한 상향식 접근이 있게 된다. 먼저 수집된 자료 (즉, 그 동물 시설에 대한 다른 척도로 얻어진 수치) 는 합쳐져서 표준 점수가 계산된다. 그리고 나서 표준점수는 합쳐져서 원칙 점수가 계산되며, 마지막으로, 얻어진 원칙 점수에 따라서 그 동물 시설에 대한 복지의 범주가 정해진다.

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