

Antimicrobial use in pigs, broilers and veal calves in Belgium

Antibioticumgebruik bij varkens, vleeskuikens en vleeskalveren in België

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A BSTRACT

Given the risks associated with antimicrobial resistance and its link with antimicrobial use, available data on antimicrobial use in the Belgian pig, broiler and veal calf production were compared. Allowing for comparison of the data available from three peer-reviewed scientific articles, the unit of measurement for antimicrobial use was the Treatment Incidence (TI), defined as the number of animals per 1000 treated daily with one 'defined' (DDDA) or 'used daily dose animal' (UDDA). Moreover, extrapolation of farm-level data to national-level data was attempted according to the European Surveillance of Veterinary Antimicrobial Consumption (ESVAC) methodology, to estimate the amount of antimicrobials used in Belgium per species. Although, among the three species, the highest TI was observed in veal calves ($TI_{DDDA}=414$, $TI_{UDDA}=379$), based on the extrapolation, it was estimated that most antimicrobials were administered to pigs (159.4 tons). Thus, the most rapid decline in the total use could potentially be achieved by targeting the pig sector. During the process of data collection for comparison and calculation, it became obvious that there is a need for harmonized monitoring programs.

SAMENVATTING

Het voorkomen van resistentie tegen antimicrobiële middelen houdt tal van risico's in. Bovendien is er een link tussen het voorkomen van resistentie tegen antimicrobiële middelen en het gebruik van deze middelen. Het doel van deze studie is de beschikbare data over het gebruik van antimicrobiële middelen in de Belgische varkens-, vleeskuikens- en vleeskalversector te vergelijken. Om de beschikbare data van drie peer-reviewed, wetenschappelijke artikelen te kunnen vergelijken, werd het gebruik uitgedrukt in behandelingsincidenties (BI), gedefinieerd als het dagelijks aantal behandelde dieren per 1000 dieren met 1 'defined' (DDDA) of 'used daily dose animal' (UDDA). Daarnaast werd getracht de data over het gebruik op bedrijfsniveau te extrapoleren naar het gebruik op nationaal niveau op basis van de methodologie van de European Surveillance of Veterinary Antimicrobial Consumption (ESVAC). Zo werd een schatting beoogd van de totale hoeveelheid antimicrobiële middelen die gebruikt worden in België per diersector. Voor de drie sectoren werd de hoogste behandelingsincidentie waargenomen in de vleeskalversector ($TI_{DDDA}=414$, $TI_{UDDA}=379$). Bij de schatting, gebaseerd op extrapolatie, werd echter verondersteld dat de grootste hoeveelheid antimicrobiële middelen toegediend werden aan varkens (159.4 ton). De snelste daling in de totale hoeveelheid antimicrobiële middelen kan dus wellicht bereikt worden door middel van acties in de varkenssector. Tijdens het collecteren van de data om berekeningen en vergelijkingen voor deze studie mogelijk te maken, werd het duidelijk dat er dringend nood is aan geharmoniseerde monitoringsprogramma's.

INTRODUCTION

The benefits of antimicrobials hardly need to be reiterated. Since their introduction, they have revolutionized the approach to the treatment, control and prevention of human and animal infections, and have contributed to major advances, ranging from increased disease treatment and life expectancy to intensified modern food production. However, for many years, antimicrobials have been prescribed pointlessly and have often been used with an imprudent prodigality. In animal production, they used to be added to feed for growth promotion (banned in Europe since 2006) (Anonymous, 2005). They have often been administered unnecessarily or overused especially in group treatments, which are generally preferred over individual treatment due to their easier application. Antimicrobials have also been purchased and used as an easier and cheaper solution to prevent or treat conditions, instead of investments in infrastructure or disinfection of the farm. Inevitably, their use has resulted in a decreasing effectiveness in treating common infections and the emergence of multi-resistant strains of bacteria, such as methicillin-resistant *Staphylococcus aureus* (MRSA) and extended-spectrum beta-lactamase producing *Enterobacteriaceae* (ESBL) (Anonymous, 2014a).

Evidence is mounting that much of the antimicrobial resistance problem is rooted in the inappropriate and excessive use of antimicrobial agents. This link between antimicrobial use and the emergence of resistance can be demonstrated at different levels, including the *in vitro* level, at which mutations have been observed to occur in genes of *Salmonella typhimurium* experimental mutants, leading to an increase of the minimum inhibitory concentration (MIC) of the antimicrobial and confirming resistance (Giraud et al., 1999; Cloeckart and Chaslus-Dancla, 2001); the individual animal level, at which Berge et al. (2005) observed a shift to increasingly multiple resistant fecal *E. coli* of feedlot steers in response to florfenicol treatment; and the farm, at which higher levels of resistance at group level are related to increased antimicrobial usage (Dewulf et al., 2007; Costa et al., 2008; Persoons et al., 2010). The link between use and resistance can also be shown at the animal sector level, at which Casteleyn et al. (2007) observed that the animal sectors characterized by a high administration of antimicrobials, i.e. poultry and pig sector, demonstrate higher levels of resistant *E. coli* than dairy cattle and wild hares; and the country level, at which Chantziaras et al. (2013) clearly demonstrated that in countries with high antimicrobial usage, higher levels of resistance are also observed in indicator bacteria.

The far-reaching burden of antimicrobial resistance, both from a human health and veterinary perspective, could be summarized as different levels of therapeutic and prophylactic failure, coupled with an increase of treatment costs for resistant infections

(Laxminarayan, 2013). Consequently, a global concern for resistance has arisen. The 2013 World Economic Forum highlighted antimicrobial resistance as a major global risk with the ability to destabilize health systems (Anonymous, 2013c). Within the same framework, the European Council called upon the member states to strengthen surveillance systems and improve data quality regarding the resistance and use of antimicrobials in human and veterinary medicine (Anonymous, 2008a; Anonymous, 2012b).

Given the risks associated with antimicrobial resistance, the possible transmission pathways of resistant bacteria between animals and humans, e.g. via direct contact, food or environment, (Wooldridge, 2012) and the overwhelming evidence that antibiotic use has been a powerful selector of resistance (Acar, and Moulin 2012; Chantziaras et al., 2013), it is crucial that the levels of antimicrobial consumption in animals are monitored for the animal species and at the national level. Besides, the quantification of antimicrobial use is currently performed at a European level, at which consumption data of antimicrobials in veterinary medicine are collected from the member states by the European Medicines Agency (EMA) in the framework of the European Surveillance of Veterinary Antimicrobial Consumption (ESVAC) project.

With a view to contributing to the above cause, this study aims to: (1) give an overview of the antimicrobial consumption in veterinary medicine in Belgium in recent years, overall and per sector, i.e. pigs, broilers, veal calves. Additionally, the type of antimicrobial agents used, their administration routes and whether they are over or under-dosed are also in focus; (2) make comparisons regarding antimicrobial consumption among the aforementioned animal sectors and over time, based on the data selected and described to address aim (1); (3) attempt to extrapolate farm-level data to national-level data of antimicrobials consumed by the Belgian pig, broiler and veal calf populations, in order to make estimations of the total use per sector in the country.

MATERIALS AND METHODS

Selection of scientific data sources

The data to address the objectives of this review were retrieved from the 2012 Belgian Veterinary Surveillance of Antimicrobial Consumption (BelVetSAC) report (Anonymous, 2012a), as well as from the study results of Callens et al. (2012), Pardon et al. (2012) and Persoons et al. (2012) for pigs, veal calves and broilers, respectively. The aforementioned report and scientific articles were considered representative to provide recent and relevant data on antimicrobial consumption in three important sectors of intensive livestock production in Belgium.

In detail, the data provided by the 2012 BelVet-

SAC report consist of all veterinary antimicrobials sold to pharmacists and veterinarians in Belgium, i.e. antimicrobial pharmaceuticals, and of antimicrobial premixes incorporated in medicated feed, between 2007 and 2012. Likewise to the 2007-2009, 2010 and 2011 reports, in the 2012 BelVet-SAC report, yearly consumption figures of antimicrobials and antimicrobial premixes (mg) are put versus the animal production expressed as produced biomass (kg), according to the methodology described by Grave et al. (2010). The biomass is calculated as the sum of the amount of pork, beef and poultry meat produced in a year, plus the number of dairy cattle in Belgium, times 500kg of metabolic weight per head. Although horses, small ruminants, companion animals and rabbits (accounting for 6% of the total biomass) are covered in the collected data on antimicrobial use, they are not taken into account when calculating the biomass.

Regarding the specific individual species, i.e. pigs, veal calves, broilers, the articles selected (Callens et al., 2012; Pardon et al., 2012; Persoons et al., 2012) all used similar methodologies and expressed antibiotic use based on the same quantitative measurement (the treatment incidence), which allows to compare results and draw conclusions. The treatment incidence (TI) is defined as the number of animals per 1000 that are treated daily with one defined daily dose animal (DDDA) or used daily dose animal (UDDA). The DDDA corresponds to the average maintenance dose for the main indication in a specified species, while the UDDA reflects the dose actually administered to the animal by the producer or the veterinarian.

The following formulas were used to calculate the TIs:

$$TI_{DDA} = [\text{total amount of drug administered (mg)}] / [\text{DDDA (mg/kg)} \times \text{number of days at risk} \times \text{kg of animal}] \times 1000$$

$$TI_{UDDA} = [\text{total amount of drug administered (mg)}] / [\text{UDDA (mg/kg)} \times \text{number of days at risk} \times \text{kg of animal}] \times 1000 \text{ (Timmerman et al., 2006).}$$

The data retrieved from Callens et al. (2012) concern the prophylactic, i.e. the administration of an antimicrobial drug to healthy animals known to be at risk, and metaphylactic, i.e. the administration of antimicrobial drugs to clinically healthy animals in contact with animals with detected clinical signs, use of antimicrobials in group treatments between birth and slaughter, i.e. one production cycle, in Belgian pig herds, and were collected retrospectively from 50 closed and semi-closed herds between January and October 2010. Data concerning sows were not included. Persoons et al. (2012) collected antimicrobial consumption records from 32 randomly selected Belgian broiler farms during two non-consecutive production cycles, in 2007 and 2008, while Pardon et al. (2012) collected prospective antimicrobial consumption data from 15 white veal farms in Belgium, between 2007 and 2009, with the complete production cycle as the study period.

Data used

The data of interest to address the aims of this article retrieved from the studies by Callens et al. (2012), Pardon et al. (2012), Persoons et al. (2012) and the BelVet-SAC report (2012a) include: quantitative information on the consumption of antimicrobials for veterinary use in Belgium, overall and per species, i.e. pigs, veal calves, broilers, expressed in tons of active substance per year, in mg of active substance used per kg of biomass produced or as treatment incidence; quantitative information on the relative use of the different active substances, overall and per species; and qualitative information regarding the administration route and the correctness of dosing, according to the Summary of Product Characteristics (SPC).

Extrapolation of farm-level data to the national level

Based on the data of Callens et al. (2012), Pardon et al. (2012) and Persoons et al. (2012), an extrapolation to the national level of antimicrobial consumption by the respective animal sectors was attempted. The objective of this extrapolation was to provide estimates on antimicrobial consumption for the actual species at the national level, and was made according to the methodology described at the ESVAC scientific guidelines paper on the collection of reliable and standardized data on the consumption of antimicrobial agents by animal species (Anonymous, 2013a), which can be summarized as follows:

Amount of antimicrobials administered nationally, per species (tons)
= amount of antimicrobials used in the studied population (tons)

× [whole national population (number of animals)]/[studied population (number of animals)]

To calculate the total amount of antimicrobials administered in pigs on an annual basis, available data on the total number of pigs slaughtered in Belgium in 2008 were used (Anonymous, 2014b). To calculate the same value for broilers, available data for the total number of broilers slaughtered in Belgium in 2008 were considered (Anonymous, 2012c). As for veal calves, the average total number of animals slaughtered in Belgium between 2009-2012 was used (Anonymous, 2014c).

RESULTS

BelVet-SAC national results

According to the BelVet-SAC report, in 2012, the total national consumption of antimicrobial pharmaceuticals for farm and companion animals in Belgium reached 222.5 tons of active substance, while

Table 1. Antimicrobial compounds most frequently used in Belgium, overall (Anonymous, 2012a) and per livestock species (% in the total of antimicrobials used) (Callens et al., 2012; Pardon et al., 2012; Persoons et al., 2012). For pigs, figures are given for both oral and injectable compounds.

Pigs		Broilers	White veal calves	Overall
Oral	Injectable			
Colistin (30.7%)	Tulathromycin (45%)	Amoxicillin (43%)	Oxytetracycline (23.7%)	Trimethoprim/sulphonamides (31.1%)
Amoxicillin (30%)	Ceftiofur LA ^a (40.1%)	Tylosin (30%)	Amoxicillin (18.5%)	Penicillins (29.7%)
Trimethoprim/sulphonamides (13.1%)	Amoxicillin (8.4%)	Trimethoprim/sulphonamides (18%)	Tylosin (17.2%)	Tetracyclins (26.3%)

a: LA, long lasting

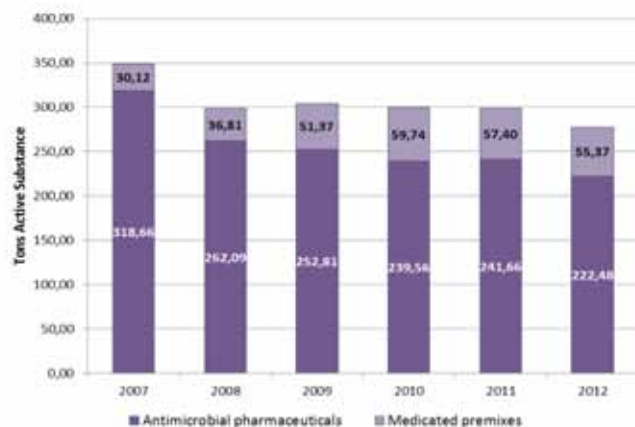


Figure 1. Total national consumption of antimicrobial compounds for veterinary use in Belgium from 2007 till 2012 (tons of active substance) (Anonymous, 2012a).

the consumption of antimicrobial premixes incorporated in medicated feed was 55.4 tons. When the above figures were put versus the amount of biomass produced in the same year (calculated as 2.033.855 tons), this gave 109.39 mg of active substance/kg biomass for antimicrobial pharmaceuticals used and 27.22 mg/kg for medicated premixes.

Compared to 2011, a substantial decrease of 7.2% in the total veterinary consumption of antimicrobials was observed in Belgium in 2012 (Anonymous, 2012a). During that year, the consumption of antimicrobial pharmaceuticals decreased by 7.9%, while the use of antimicrobial premixes decreased by 3.5%. Looking further backward, a promising decreasing trend of 20.3% in the total consumption can be observed between 2007 and 2012, when the first Bel-Vet-SAC data collection procedures were started (Figure 1).

The antimicrobial compounds most frequently used in 2012 were the combination of sulphonamides and trimethoprim, followed by the antimicrobial classes of penicillins and tetracyclines (Table 1). Compared to 2011, the use of the last two was reduced by 6.1% and 13% respectively, in 2012, whereas the use of sulphonamides and trimethoprim was increased by 1.6%.

Compared to 2011, the consumption of cephalosporins (especially of the third and fourth generation) and quinolones (especially the fluoroquinolones) was increased in 2012 (2.7% and 3.1%, respectively). Even though this increase was limited in absolute values of active substance, it is of concern since these groups of antimicrobials are listed as critically important for resistance selection in both humans and animals by the World Health Organization (WHO) (Anonymous, 2011) and the World Organization for Animal Health (Anonymous, 2008b). Moreover, this trend has been observed for a second year in a row.

Antimicrobial use in Belgian pig farms

Callens et al. (2012) quantified the antimicrobial drug consumption in Belgian fattening pig farms expressed in TI. The average values for TI_{DDDA} and TI_{UDDA} were 235.8 and 200.7. This means that on average, 235 pigs were treated with one DDDA and 200 were treated with one UDDA. These values were higher than the values calculated by Timmerman et al. (2006), which were based on data collected in the same way in 2003 (178.1 and 170.3, respectively). In particular, TI_{UDDA} increased by almost 18%. It should also be mentioned that a large variation among the treatment incidences of different herds has been observed (Callens et al., 2012) (Figure 2).

The oral and injectable antimicrobials most frequently used in pig production are shown in Table 1. They are expressed as a percentage of the total amount of antimicrobials used. Callens et al. (2012) found that the majority of group treatments are administered during the farrowing and battery period, while much less treatments are administered during the fattening period. On average, 80% of antimicrobial treatments in pig production are administered before the age of ten weeks. Callens et al. (2012) also concluded that prophylactic antimicrobial group treatment was applied in 93% of all group treatments, whereas metaphylactic or curative treatments were applied in only 7% of the cases.

The main reasons for antimicrobial use include di-

gestive disorders and streptococcal infections in piglets, as well as respiratory problems during the second half of the battery period (Callens et al., 2012). In the study, group treatments were primarily administered via the parenteral route in sucking piglets and orally in piglets after weaning via the feed or drinking water. Generally, oral treatments were more common than injectable ones ($TI_{UDDA, oral} = 176.5$, while $TI_{UDDA, injectable} = 24.2$). Injectable treatments were frequently overdosed (79.5% overdosed, 8.2% correctly dosed, 12.3% underdosed), while oral administrations were often underdosed (47.3% underdosed, 23.3% correctly dosed, 29.4% overdosed).

Based on the data of Callens et al. (2012), the extrapolated amount of antimicrobials consumed by the national pig population is estimated to be 159.4 tons. It should be noted that this value refers to (prophylactic and metaphylactic) group treatments in fattening pigs only, and does not include therapeutic use nor antimicrobials used in sows.

Antimicrobial use in Belgian broiler farms

Persoons et al. (2012) estimates that the average treatment incidences based on the defined daily dose (TI_{DDDA}) and the actual dose applied (TI_{UDDA}) equal 131.8 and 121.4 daily treated broilers per 1000, respectively. Likewise to pig farms, considerable variations exist in antimicrobial use between farms (Figure 3). Twenty two percent (7/32) of the farms in the study managed to grow broilers without using antimicrobials in both of the production rounds monitored. In the treated farms, antimicrobials were

used in 75% of the production cycles and were almost exclusively administered via drinking water in group treatments. Individual treatment in poultry is practically difficult and therefore seldom performed.

The antimicrobials most frequently used in broiler production are given in Table 1. In particular, amoxicillin and tylosin were administered in more than half of the treatments examined by Persoons et al. (2012). They are both classified as critically important antimicrobials (class I) for both human and animal health by WHO (Anonymous, 2011) and OIE (Anonymous, 2008).

The main reasons for antimicrobial administration in broilers are necrotic enteritis and dysbacteriosis, followed by feet disorders, coccidiosis and respiratory problems (Persoons, 2012). In the average flock of the study, most of the antimicrobials administered were usually dosed within the range of correct dosing. However, tylosin was usually underdosed, while amoxicillin and trimethoprim-sulphonamide were slightly overdosed.

According to the ESVAC methodology and based on the data of Persoons et al. (2012), the annual amount of antimicrobials consumed by the Belgian broiler population is estimated to be 26.5 tons.

Antimicrobial use in Belgian veal calf farms

Pardon et al. (2012) calculated the TI, based on the DDDA (TI_{DDDA}) and the UDDA (TI_{UDDA}) and considering the actual live weight of the animals, as 414 and 379 calves treated with one daily dose of antimicrobial agents per 1000 animals, respectively. Also

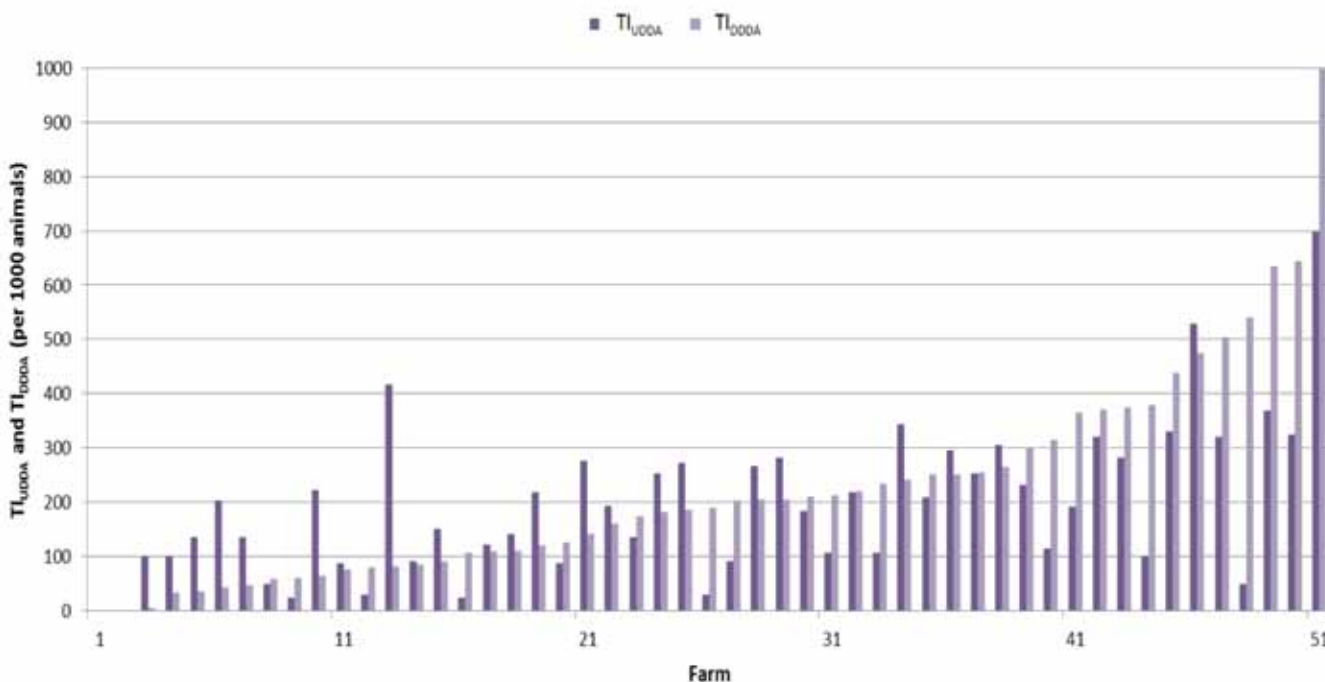


Figure 2. Treatment incidence based on the “used daily dose animal” (UDDA) and the “defined daily dose animal” (DDDA) in 50 pig farms in Belgium (Callens et al., 2012).

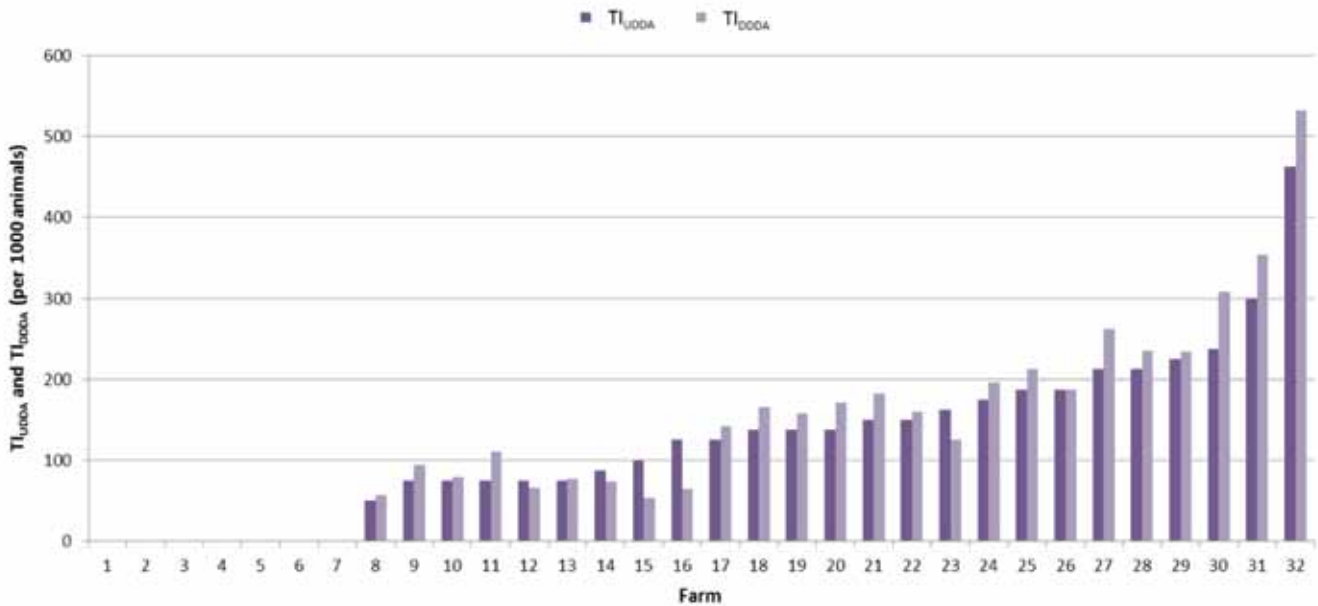


Figure 3. Treatment incidence based on “used daily dose animal” (UDDA) and “defined daily dose animal” (DDDA) in 32 broiler farms in Belgium in two non-consecutive production cycles (Persoons et al., 2012).

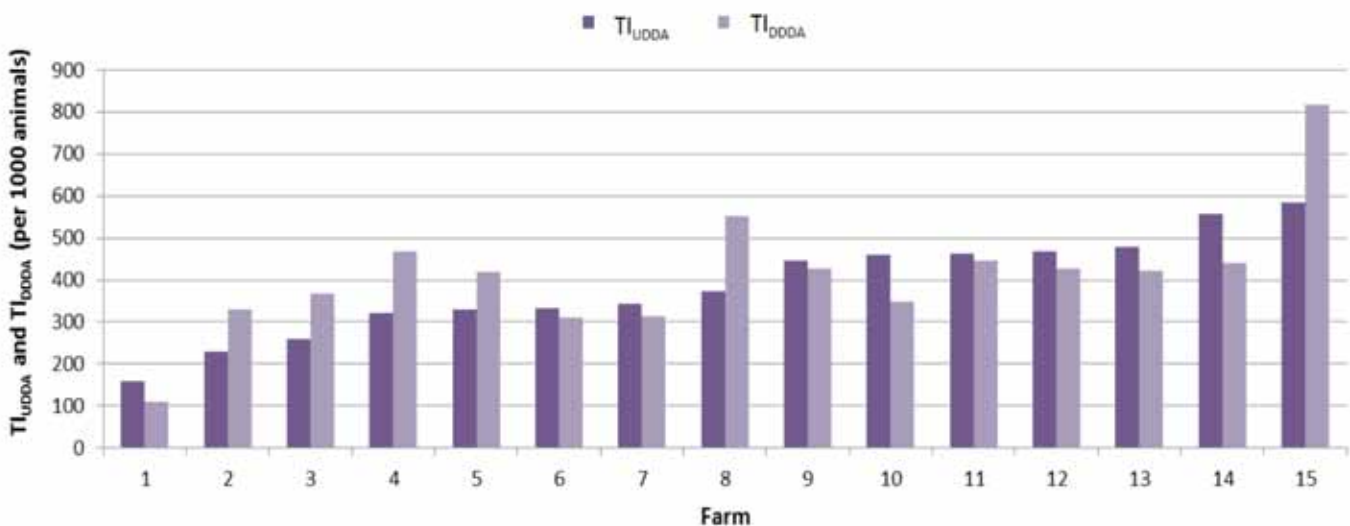


Figure 4. Treatment incidence based on “used daily dose animal” (UDDA) and “defined daily dose animal” (DDDA) in 15 white veal calf farms in Belgium (Pardon et al., 2012).

in the veal calf sector, a relatively large variation between farms regarding antimicrobial use was observed (Figure 4).

Table 1 includes the most frequently used antimicrobials for group treatments of white veal calves, which are classified as critically important for public health (Pardon et al., 2012). Thirteen percent of the antimicrobial group treatments were administered prophylactically and 87% metaphylactically. The main indication for administration was respiratory disease (53%). Other common indications were arrival prophylaxis (13%), diarrhea (12%) and dysbacteriosis (12%). Group treatments were used in 97.9%

of the cases and were all orally administered in milk.

The antimicrobials were mostly overdosed ($TI_{UDDA} < TI_{DDDA}$). However, likewise to pigs, over 40% of group treatments were underdosed. Especially oxytetracycline and tylosin, when used to treat dysbacteriosis, were systematically and significantly underdosed.

The data of Pardon et al. (2012) were considered representative to be used for extrapolation to the national level, based on which the annual antimicrobial consumption in white veal calves is estimated to be 25.2 tons.

DISCUSSION

When it comes to interpreting antimicrobial consumption data, the unit of measurement as well as the use of standard measurement units for time at risk and average weight of animals at time of treatment, are crucial. The scientific data sources selected for this study provide data on the consumption of antimicrobials for veterinary use in Belgium, and are expressed in different ways.

Firstly, the BelVet-SAC report provides overall data for farm and companion animals expressed in tons of active substance per year and in mg of active substance used per kg of biomass produced. This approach is similar to the one used by the European Medicines Agency (EMA) in the ESVAC reports, where consumption data from EU countries are presented in mg of active substance per population correction unit (PCU), a unit of quantification of animal production comparable to the biomass. Although crude and not detailed enough for between-species differentiation, the BelVet-SAC report data provide an interesting insight into the evolution of the total antimicrobial use of the past years.

In contrast to the 2012 BelVet-SAC report, the selected scientific articles provide data per species, i.e. pigs, veal calves, broilers, quantified as treatment incidence (TI) of antimicrobials, at the end-user level. Being based on a sample of herds, these studies do not give a complete overview of the total antimicrobial consumption in Belgium as the BelVet-SAC report does. Additionally, the sampled farms were partially selected according to the willingness of the farmers to cooperate. Hence, there is an inherent risk of bias that should be taken into account. However, the sampled farms provide an insight into the antimicrobial use per species, which is detailed in terms of including data on the microbial agents used, their dosages, indications for administration, and also show a wide, and skewed distribution in use between herds and production types. This signifies that some herds manage to grow their animals without using antimicrobials, while others do not.

Since all three articles used a similar methodology, i.e. TI, the data they provide can be compared, despite referring to different sectors, sample sizes and years of data collection. Based on a general comparison of the TIs estimated for pigs, broilers and veal calves, it was observed that antimicrobial use is more frequent in veal calves ($TI_{DDDA} = 414.0$, $TI_{UDDA} = 379.0$), followed by pigs ($TI_{DDDA} = 235.8$, $TI_{UDDA} = 200.7$) and broilers ($TI_{DDDA} = 131.8$, $TI_{UDDA} = 121.4$) (Figure 5). The very high usage in veal calf production is most likely explained by the typical organization of the veal industry and more specifically, by the way veal calves are collected. Furthermore, it is known that the incidence of antimicrobial treatments in veal calves is much higher than in conventional dairy and beef cattle, 6.3 and 5.4 per 1000 cattle, respectively (Pardon et al., 2012).

From a methodological point of view, the use of TI as an indicator of antimicrobial consumption is more relevant in terms of estimating selection pressure for antimicrobial resistance than the total weight of antimicrobials consumed. Moreover, this method overcomes the issue of differences in molecular weight between different antimicrobial products. If antimicrobial use is systematically quantified in the same way and converted to the same denominator, comparable data may be available and can then be used to follow up the amount of antimicrobials used in different sectors or farms and over time (Timmerman et al., 2006). Besides, in a European framework, an equivalent indicator to the TIs, i.e. the number of defined daily dose animals (DDDA) consumed by weight group/1000 animals produced or livestock/year, is proposed by the EMA to be used in a standardized manner for reporting the consumption of antimicrobial agents by species (Anonymous, 2013a). At this point, it should be pointed out that the average animal weight at treatment used in the calculation of TI has a large influence on the obtained results. Therefore, this weight should always be exam-

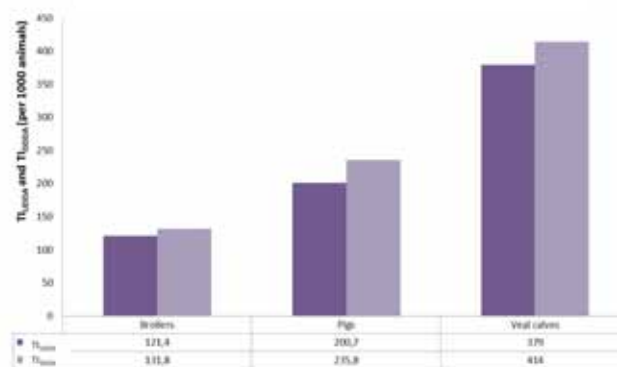


Figure 5. Comparison of the treatment incidences among Belgian broilers, pigs and veal calves.

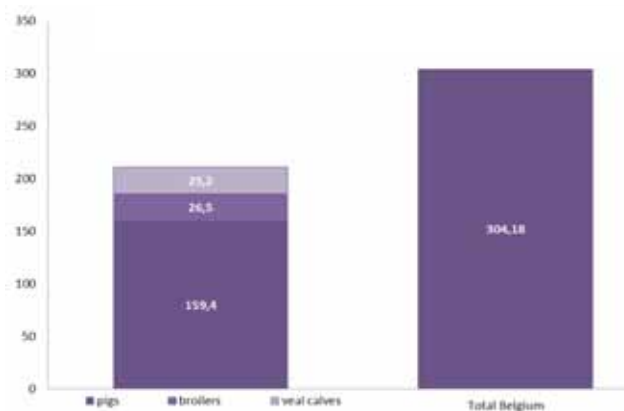


Figure 6. Left column: estimated amount in tons of antimicrobials used annually in Belgian pigs, broilers and veal calves at the national level, after extrapolating farm-level data from selected studies. Right column: total amount in tons of antimicrobials and medicated pre-mixes used in Belgium in 2009 (Anonymous, 2012a).

ined with caution to prevent over or underestimation of the TI. Although the use of actual weights of the animals at treatment is laborious, it provides more accurate estimates of TIs.

The difference in methodologies does not allow for immediate comparisons between the BelVet-SAC report and the scientific articles. However, extrapolation from the farm-level data to the national-level data was attempted, based on the methodology described at the ESVAC scientific guidelines paper on the collection of reliable and standardized data on the consumption of antimicrobial agents by animal species (Anonymous, 2013a).

According to this extrapolation attempt, pigs (sows not included) consume most antimicrobials at the national level in Belgium, i. e. 159.40 tons annually, followed by broilers (26.53 tons) and white veal calves (25.18 tons), which, as already shown, have the highest TI. The relative contribution of the different animal species to the total use is shown in Figure 6, where the results are compared to the total use in 2009, the year considered as the most suitable in accordance with the years of data collections. It should be noted that this value remained almost constant from 2008 till 2011 (Figure 1). According to the gathered data and estimations, the use of antimicrobials in pigs, broilers and veal calves corresponds to 69.4% of the total use in Belgium. Yet, the extrapolation and the relative contribution should be interpreted with caution and only be seen as indicative. Several sources of uncertainty are possible, which are related to the representativeness of the sampled herds and to the fact that treatments in sows and curative treatments were not taken into account at the pig herds. Hence, caution is urged in concluding that the difference between the two columns reflects the antimicrobial use in dairy and beef cattle, small ruminants, horses, layers and companion animals.

Despite these calculations being rough due to the limited data available, it is important to attempt such extrapolations of data to the national level or even to the regional level, depending on the country. The results may prove useful, since they can provide estimates on sales and consumption of antimicrobials at the species level, and possibly per weight category and production type, as well as on data pools for further (combined) analyses, e.g. ecological or economic analyses. Overall, they could be used to support the targeting of monitoring procedures and efforts to reduce antimicrobial usage.

Regarding the antimicrobial compounds, those belonging to the WHO critically important list are frequently administered in all three species (Calens et al., 2012; Pardon et al., 2012; Persoons et al., 2012). Despite the overall decrease in antimicrobial consumption in Belgium in recent years, the use of molecules of critical importance for human medicine has remarkably increased for a second year in a row.

In this study, a number of needs regarding antimicrobial consumption data and related practices were

observed. A wide and more detailed data collection covering all production sectors is needed and is important for benchmarking, monitoring and analysis of trends. Additionally, it would be appropriate to use differentiating statistics per animal production sector when comparing different countries, where the type of production system may differ (intensive, extensive). This monitoring work should be repeated every year in a harmonized manner, using the same quantification units. In line with this, scientific articles and reports, in which a more or less uniform methodology is used, would allow broader and more accurate comparisons, e.g. between countries. In addition, it seems that clear guidance on correct dosing needs to be provided on a regular basis to veterinarians, farmers and other stakeholders responsible for antimicrobial administration to animals.

According to the third ESVAC report of EMA for 2011, Belgium holds the sixth position in terms of sales volume of antimicrobials over 25 EU countries (Anonymous, 2013b). The previous year, Belgium was in third place. Since there was virtually no change in use in Belgium between 2010 and 2011, the change in positioning is solely the result of the addition of new countries with a higher consumption in the dataset, which had not provided data previously. Both places are high. For that reason, the reduction in the antimicrobial use observed by the BelVet-SAC in 2012 is hoped to be maintained (Anonymous, 2012a). This reduction in antimicrobial consumption in Belgium (Anonymous, 2012a) and also in Europe (Anonymous, 2013b) over the last few years is a promising trend. However, this reduction should not be taken for granted and efforts should be continued towards this direction. At the Belgian level, the Centre of Knowledge for Antimicrobial Consumption and Resistance in Animals (AMCRA) aims to promote the prudent use of antimicrobials, and has produced a list of guidelines on responsible antimicrobial consumption, where the various antimicrobial classes are differentiated in terms of importance for public and animal health according to the WHO and OIE lists (Anonymous, 2011; Anonymous, 2014d).

In other words, antimicrobials need to be used sustainably. From a Belgian perspective and given that the use in the three major livestock species accounts for a large proportion of the total use, this could be translated to sector targeting actions. Besides, it has been shown here, that despite of the veal sector demonstrating the highest frequency in use per animal head, the pig sector demonstrates the highest consumption in absolute values at the national level (Figures 5 and 6). Simultaneously and next to this quantitative approach, it is very crucial that producers of smaller industries, e.g. the veal calf sector, embrace active responsibility in this global health issue, and that all sectors endorse antimicrobial stewardship.

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Mededeling

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