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## ABSTRACT

The veterinary profession in Southeast Europe faces a structural imbalance: while companion-animal medicine dominates employment opportunities and student preferences, food-animal health, public health, and One Health functions are increasingly under-resourced. This study examines veterinary education establishments (VEEs) from Slovenia, Croatia, Bosnia and Herzegovina, Serbia, and North Macedonia to assess how international standards (WOAH Day-1 Competencies; EAEVE/ESEVT) and market forces shape veterinary education. Although VEEs already achieved or tend to accomplish and maintain compliance with accreditation requirements and update curricula to meet EU standards, implementation often reflects student demand and clinical caseloads rather than regional epidemiological or food security needs. Our findings highlight the need for VEEs to rebalance curricula by embedding WOAH's competencies alongside EAEVE's standards, strengthening extramural learning in food-animal and public-health contexts, and developing joint regional strategies such as shared electives, micro-credentials, and mobility programs. Without such proactive measures, veterinary education risks reinforcing market-driven specialization at the expense of essential societal roles. These lessons extend beyond Southeast Europe, offering a framework for aligning veterinary education globally with both professional demand and public-good imperatives.

## 1. Introduction

Throughout its history, the veterinary profession has continually adapted to meet society's needs. Today, however, it faces a profound structural shift in which an increasing concentration of resources and expertise in companion animal sec-

tor threatens to erode its capacity to serve broader public-good functions. The Federation of Veterinarians in Europe (FVE) survey from 2023 shows that the most common employment sector is clinical practice (63%), predominantly small animal clinical practice (70%), followed by public service (14%), education and research (6%) and industry (4%). In

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terms of caseload, companion animals account for 58% of all cases treated, compared to 10% for cattle, 7% for equines, and 3% for pigs. This market profile reflects rising demand for companion-animal care but poses concerns about sustaining food-animal, public-health, and One Health capacities of profession.

The workforce trend is closely intertwined with profession's educational basis. The standards and accreditation systems that shape veterinary education, as the frameworks used to define graduate competencies, strongly influence how future veterinarians are prepared to meet—or fail to meet—societal needs beyond the dominant companion-animal sector. The Southeast European region offers a distinctive case for studying veterinary education perspectives. Emerging from a centrally planned economic model with publicly owned veterinary stations (clinics) established for each municipality, was aimed to secure all range of professional services on self-sustainable basis. More than 35 years into the transition to market economies, the region now spans EU members (Slovenia and Croatia) and EU candidate states (Bosnia and Herzegovina, Serbia and North Macedonia). Despite varied EU integration levels, countries remain interconnected through significant cultural, societal and economic aspects including intra-regional trade in live animals, meat, dairy, and feed. These trade flows sustain rural economies and regional food security but also create shared vulnerabilities to transboundary animal diseases and joint public-health responsibilities.

It is commonly accepted that the EAEVE-aligned curricula and competencies across borders can strengthen disease prevention and treatment preparedness, facilitate EU compliance, and enhance market competitiveness. However, such harmonization, in response to current employment opportunities, can reduce flexibility for local adaptation, potentially marginalizing region-specific needs, and fostering an over-standardized approach that may not adequately reflect diverse epidemiological, cultural, or economic contexts. While Southeast Europe's conditions are unique, the lessons from this collaborative evaluation—particularly in balancing market demand with public-good functions—can inform other small economies with high agricultural trade and similar veterinary workforce challenges that are by rule dependent on single Veterinary educational establishment (VEE). To address identified challenges, this study aims to analyze current accreditation and quality assurance standards

and impact on how VEEs shape veterinary education trends and priorities, survey educational statistics from five regional veterinary faculties to document institutional facts and realities in enrolment, curriculum content, postgraduate offerings, and graduate orientation toward professional sectors and recommend future development and strategic pathways for VEEs highlighting how regional collaboration and innovations can strengthen their respond to professional demand, keep One Health competencies, and reinforce proactive educational design.

## 2. Materials and methods

### 2.1 Analysis of relevant accreditation and quality assurance standards in veterinary education

The first step consisted of a comparative analysis of two major veterinary education quality frameworks:

- WOAH Day 1 Competencies for Graduating Veterinarians (2012)
- EAEVE/ESEVT Standards and Indicators (2023)

The analysis examined competency domains, Quality assurance and governance and sectoral balance.

### 2.2 Survey of educational data in participating VEEs

A structured survey instrument was developed and administered to five VEEs, two from EU member states (Ljubljana and Zagreb – both EAEVE accredited) and three from EU candidate countries (Sarajevo, Belgrade, and Skopje).

The survey comprised five sections covering:

- Student demographics and enrolment trends (past five academic years)
- Postgraduate and specialization programs, including emerging areas
- Curriculum structure, reforms, and educational priorities
- Employment opportunities trends and systemic issues (interest in public-good sectors, graduate employment)
- Institutional perspectives on external drivers of curriculum direction, partnerships, and mobility programs

Questionnaires were distributed electronically, with responses validated through follow-up communication with designated institutional contacts. The survey captured both quantitative data (enrolment, graduation numbers, gender ratios, elective choice trends) and qualitative descriptions (curriculum reform narratives, employer engagement practices, mobility participation).

2.3. Analysis of population and livestock data

Cross-analysis of population and animal data were used to identify gaps between veterinary capacity and production realities. The Livestock Unit (LSU) is used as a standardized measure of animal biomass, using coefficients that convert species counts to a common reference (1 LSU = an adult dairy cow’s annual feed requirement). Livestock units (LSU) were calculated using conversion coefficients established in the EU Farm Structure Survey framework (Commission Regulation (EC) No 1200/2009). For comparability, we applied the following simplified coefficients: cattle = 1.0, pigs = 0.3, sheep = 0.1, goats = 0.1, poultry = 0.007, and use formula: LSU total = (Cattle × 1.0) + (Pigs × 0.3) + (Sheep × 0.1) + (Goats × 0.1) + (Poultry × 0.007) Non companion animals veterinarian’s ratio

for further analysis is approximated at 30 % of registered veterinary workforce based on FVE survey (2023).

2.4. Formulation of recommendations for future collaboration and study programs improvements.

Insights from the standards analysis, survey results and literature review were used to develop evidence-based recommendations.

3. Results

3.1. Competency Frameworks: WOAH vs EAEVE approaches and educational impacts

Veterinary graduate competencies are foundational to curriculum design, accreditation standards, and workforce alignment. Two dominant frameworks—those of the World Organization for Animal Health (WOAH, 2012) and the European Association of Establishments for Veterinary Education (EAEVE, 2023) present distinctive yet complementary visions for the profession’s entry-level expectations. Understanding their orientation, structure, and impact is critical for rebalancing veterinary education.

Table 1. Comparative summary of structural distinctions of WOAH/EAEVE standards

Dimension	WOAH (2012)	EAEVE/ESEVT (2023)
Orientation	Global minimum set of competencies for WOAH members, regulatory support	European professional mobility and clinical readiness
Competency format	Broad domains (e.g., zoonoses, epidemiology)	Specific clinical and public health competencies grouped under 5 core categories
Primary focus	National veterinary services, disease surveillance, One Health	Balanced training for all major animal species, integrated public health modules
Public health emphasis	Strong (food safety, transboundary animal diseases, veterinary public health (VPH)	Moderate to strong (integrated in core curriculum)
Clinical skills detail	Limited	Extensive (clinical reasoning, procedures, species-specific care)
Communication & ethics	Implicit	Explicit, including client interaction and ethical conduct
Legal/regulatory training	Emphasis on legislation for public service roles	Included in understanding business, ethics, and professional responsibilities
Use in accreditation	Informal benchmarking	Mandatory in ESEVT accreditation

### 3.2. Student enrolment and gender distribution

Graduation numbers varied widely by institution size, from ~30 graduates per year in smallest VEE to over 120 in largest one. Across all VEEs female graduates predominated, typically constituting 60–85% of the total.

### 3.3. Postgraduate and specialist programs

All VEEs offer postgraduate education, though the number and scope vary:

- Belgrade and Zagreb run extensive specialist modules covering clinical, public health, food safety, and epidemiology.

- Sarajevo's offer centers on "Veterinary Medicine and Public Health." with wide variety of tracking
- Skopje delivers a specialist program in *Food Safety and Quality* and doctoral tracks in veterinary medicine and food safety.
- Ljubljana provides interdisciplinary doctoral program in biomedicine and environmental protection.

No institutions dedicate programs for emerging fields such as digital veterinary medicine, veterinary business management, aquatic health disease management though some integrate relevant topics (e.g., One Health, economics and management) into core curricula.

**Table 2.** Data on student enrolment and gender distribution are presented for each VEEs

VEE	Enrolment and gender distribution
University of Belgrade	The recorded a steady enrolment around 1,340–1,370 students annually, with a growing female majority (from 53% to 65%).
University of Zagreb	The maintained ~900–1,000 students across Croatian and English programs, with a female share consistently above 75%.
University of Sarajevo	The enrolled ~300–380 students annually, with females comprising ~65%–70% of the cohort.
University of Skopje	The showed smaller cohorts (120–134 students) but a similarly high female proportion (~67%).
University of Ljubljana	The averaged ~430 students per year, with an ~84% female majority.

### 3.4. Curriculum structure and reforms

All VEEs reported curriculum updates within the last five years, generally aimed at alignment with EAEVE and EU requirements. External Drivers of curriculum direction are:

- EAEVE and EU Directive (2005/36/EC) compliance;
- National accreditation standards;
- Employer feedback through councils or structured surveys;
- Labor market demands and professional chamber requirements for practical skills and public-good sector readiness.

### 3.5. Interest in public sector

All VEEs observed declining student interest in food-animal medicine, public health, and public sector careers:

- Belgrade recorded a drop in public health elective enrolments from 147 (2019/20) to 59 (2024/25).
- Zagreb noted that most final-year students select the companion-animal ("Pets") track.
- Ljubljana's internal survey found decreasing interest in most veterinary areas between Year 1 and Year 6, except for dogs/cats, pharmacy, and research.

**Table 2.** Comparative overview of VEEs curriculum structure

Institution	Program type	Duration/ ECTS	Notable inclusions	Curriculum updates
Ljubljana (SLO)	Integrated I and II cycle study	6 years/360 ECTS	EAEVE-accredited; Broad species coverage; electives in public health, communication skills, entrepreneurship, aquaculture health	Increased early clinical exposure, optimized rotations, added courses on exotic animal medicine, environmental safety, antimicrobial resistance (AMR), and sustainable protein sources.
Zagreb (CRO)	Integrated I and II cycle study	6 years/360 ECTS	EAEVE-accredited; structured electives in food safety, public health, and companion-animal medicine tracking in final year	Conducted comprehensive learning outcomes mapping, increasing visibility of Day One Competencies and harmonized with the Croatian Qualifications Framework.
Sarajevo (BiH)	Integrated I and II cycle study	5 years/300 ECTS	Bologna-model; core veterinary training; public health and food safety emphasis in later years; postgraduate program in Veterinary Medicine & Public Health	Modernized content to meet EU Directive 2005/36/EC, adding up to 30% new content.
Belgrade (SRB)	Integrated I and II cycle study	6 years/360 ECTS	Strong food-animal base with growing companion-animal focus	Reduced overall teaching hours, shortened program from 12 to 11 semesters, introduced a One Health course, and expanded clinical rotations in the final semester.
Skopje (MKD)	Integrated veterinary medicine program	5,5 years/330 ECTS	Covers all major species; includes food safety, public health, and One Health elements;	Extended program to six years (360 ECTS), introduced one-semester courses for balanced workload, and added new electives.

3.6. Graduate employment trends

Employment outcomes are generally favorable, though tracking systems differ:

- Some VEEs rely on national agencies or professional chambers for employment data (Belgrade, Zagreb, Skopje, Ljubljana).
- Sarajevo does not systematically track graduate employment.

3.7. Partnerships and mobility

All faculties maintain partnerships with private practices, farms, food industry facilities, and public health institutes, providing clinical and field training opportunities. Participation in EU mobility programs (Erasmus+, CEEPUS) is continuously growing, supporting both student and staff exchanges.

3.8. Population statistic

**Table 3.** Livestock statistics and livestock unit calculation (LSU) per country

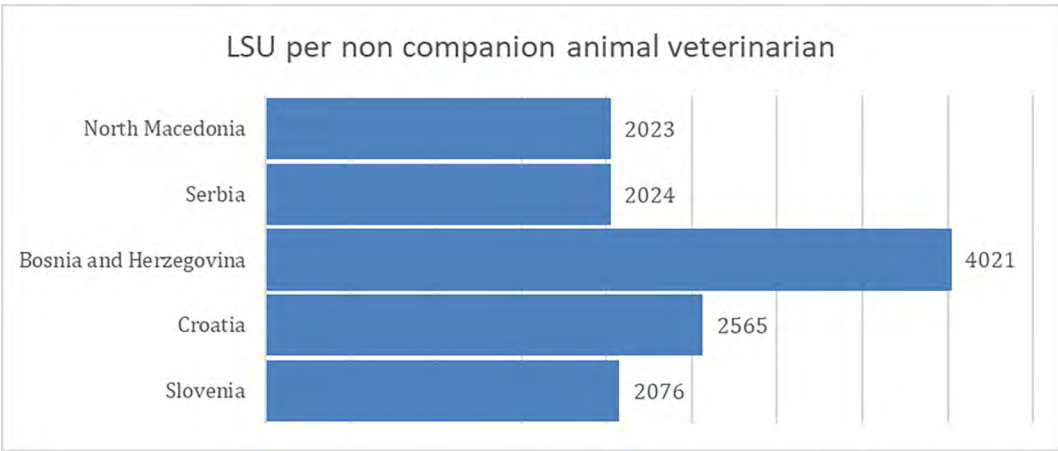
Country (Year)	Cattle	Pigs	Poultry	Sheep	Goats	LSU total*
Slovenia (2024)	454,000	232,000	6,500,000	116,800	25,100	<b>583,290</b>
Croatia (2022)	422,000	945,000	10,918,000	643,000	82,000	<b>854,426</b>
Bosnia & Herzegovina (2024)	383,000	447,000	17,547,000	1,099,000	62,000	<b>756,029</b>
Serbia (2024, prelim.)	698,605	2,349,176	14,773,571	1,759,424	~180,000*	<b>1,700,715</b>
North Macedonia (2023)	148,693	193,412	1,562,000**	587,073	85,528	<b>284,911</b>

**Sources:** Slovenia (2024): Statistical Office of the Republic of Slovenia (SURS); Croatia (2022): Croatian Bureau of Statistics (DZS). Bosnia & Herzegovina (2024): Agency for Statistics of BiH (BHAS). Serbia (2024, prelim.): Republic Statistical Office of Serbia (RZS, preliminary); goat numbers estimated from a 2021 research article (*Frontiers in Veterinary Science*). North Macedonia (2023): State Statistical Office of North Macedonia (SSO).

**Notes:** \*Serbia goat number approximate; North Macedonia poultry estimated from 2022 yearbook with +11.8% growth in 2023.

**Table 4.** Veterinarian Workforce Distribution (ratio estimates based on FVE, 2023)

Country	Population (2025 est.)	FVE Ratio (vets / 1,000 pop.)	Estimated Total vets	Companion-animal vets (70%)	Food/ Public vets (30%)
Slovenia	2,130,850	0.44	≈ 938	≈ 657	≈ 281
Croatia	3,964,392	0.28	≈ 1,110	≈ 777	≈ 333
Bosnia & Herzegovina	3,137,079	0.20	≈ 627	≈ 439	≈ 188
Serbia	6,689,039	0.39	≈ 2,609	≈ 1,826	≈ 783
North Macedonia	1,812,654	0.13	≈ 236	≈ 165	≈ 71



**Figure 1.** Estimation of total LSU per currently practicing non companion animal veterinarian for each country



## 4. Discussion

As a public good, veterinary profession, including its educational base, has a responsibility to balance with societal needs, ensuring that specialization thrives without compromising critical capacities. While a current market-driven focus on companion-animal services has demonstrated direct correlation with development of deeper specialization and technical excellence in veterinary education (Drzemalla et al., 2025), it risks narrowing the profession's scope—leaving essential roles in food-animal medicine, food security and safety, disease events surveillance, and One Health under-resourced, and reshaping educational institutions in ways that may weaken their ability to serve society with a balanced workforce (Leighton, 2004, Enticott et al., 2011, Fejzić and Šerić-Haračić, 2017). Today, VEEs face divergent driving forces: to follow the trending companion-animal market pull or to steer curricula and policy toward broader societal resilience. This challenge is complicated by two parallel phenomena: the corporatization of companion-animal practice, which reshapes clinical priorities and early-career pathways, and persistent workforce vulnerabilities such as high attrition, rural recruitment gaps, and mental health pressures (Diana et al., 2025; Zoetis, 2025). VEEs, particularly public ones, bear a special responsibility in sustaining and shaping the veterinary profession to meet future needs and requirements. Their role extends beyond cooperation in developing educational models (Arnold and Warman, 2025), rather a new proactive stance is demanded - one that anticipates societal and professional challenges and strategically prepares graduates to respond. Veterinary education cannot stand in isolation. It is intrinsically tied to the profession and, now more than ever, requires systematic and proactive alignment between academic foundations and the evolving imperatives of veterinary profession.

The first objective of our study was to examine how international frameworks—principally WOA's Day One competencies and the EAEVE/ESEVT standards—shape veterinary education, and the results (Table 1.) highlight both their complementary strengths and the structural gaps that emerge in practice. WOA's approach emphasize the veterinarian's role in safeguarding public health, ensuring national veterinary service quality, and supporting emergent issue such as biosecurity, emergency responses and antimicrobial resistance (AMR). The WOA framework is globally oriented and explicitly emphasizes

that veterinarians must be equipped not only in clinical care but also in public-goods areas such as food security and safety, AMR, and One Health. Complementing this global perspective, EAEVE's competency structure, as embedded in the ESEVT SOP 2023 and Annex 2, aligns with EU directives (2005/36/EC, 2013/55/EU) and the European Higher Education Area's (EHA) quality assurance standards (ESG 2015). The EAEVE model's focus on clinical competence has profoundly shaped European veterinary curricula. VEEs are required to provide extensive hands-on training, through teaching hospitals and extramural placements. This shift has professionalized veterinary training, enhanced graduate autonomy, and facilitated EU workforce mobility. While it is true that implementation often becomes companion-animal heavy (due to student preferences, hospital caseloads, or VEEs resources), this is not a feature of EAEVE policy itself, but rather a consequence of how VEEs allocate teaching time to meet compliance. The framework itself does not deprioritize public health. Rather, the practical weight in curricula may drift toward clinical companion-animal training due to student demand and clinical practice economics but this is an implementation challenge, not a design flaw in ESEVT. However, in practice, the predominance of clinical training has sometimes meant that public-good roles receive less attention. Graduates as per various studies feel underprepared for careers in food safety, rural practice, and government service—domains central to WOA's competency vision (Enticott et al., 2011, Sander and Miller, 2021). This competency mismatch raises concerns about resilience during public health emergencies, where veterinary services play key roles (FVE, 2023). These findings suggest that while VEEs meet set of accreditation criteria, they may lag in internalizing and operationalizing holistic competencies that support public-health resilience.

Curriculum rebalancing and implementation must avoid choosing between models. Instead, integrated frameworks can leverage EAEVE's clinical depth and WOA's public health breadth. Curriculum designers should map each course outcome to both EAEVE and WOA standards, ensure exposure to public health and food-animal practice and collaborate with public-sector agencies for training placements. Our findings demonstrate concrete evidence of the regional pattern:

- Curriculum orientation, if aimed to follow market trends and requirements, will be heavily weighted toward companion-animal practice,

with limited structural emphasis on food-animal medicine and public health.

- Postgraduate offerings lack systematic focus on emerging fields such as digital veterinary medicine, aquatic animal health, public advocacy, economics, communication and population-level medicine (One health).
- Graduate career aspirations follow similar trends: rising student interest in private clinic employment, declining inclination toward public-good roles.

These observations mirror literature (*National Research Council*, 2013; *Cary et al.*, 2017; *AVA*, 2025) highlighting the profession's urban tilt and the consequent neglect of food production and population health training — a concerning trend given the region's heavy reliance on agri-food trade and epidemiological risk interconnectivity.

Given that Southeast Europe represents a region with post-socialist educational legacies, varying levels of EU integration (two EU member states and three candidate countries), and dense agri-food trade networks, studied VEEs operate within a unique socio economics and political context. Traditional regional interconnectedness—the trade of livestock, dairy, and meat production—carries both economic consequences and epidemiological vulnerabilities. Mixed human migrations and transboundary animal diseases have repeatedly posed the risk to spread across regional borders (*Angeloni et al.*, 2023), underscoring the urgency of veterinary capacity for surveillance, epidemiological response, and certification. Thus, there is both a market imperative—to sustain significant value in intra-regional and EU-bound trade—and a public health imperative—to mitigate disease risks through education and preparedness. VEEs that embed these dual priorities into curricula enhance regional resilience and alignment with EU market requirements. Our study strongly supports a proactive stance by VEEs: not merely following market signals but standing guard to veterinary professional identity to include public-good service and orientation to emerging fields. Formulating regional collaborative strategies—joint curriculum mapping, shared micro credentials in One Health, food safety, epidemiology, and economics—is essential.

Across all VEEs surveyed, total enrolment over the past five academic years has remained relatively stable, with some institutions reporting slight declines in recent intakes. Female students con-

sistently outnumber male students, representing between 60% and 85% of total enrolments depending on the institution. Veterinary medicine, previously a male-dominated profession in region of our study, has experienced a significant increase in the number of women studying at VEEs and practicing in all fields of the profession. Female predominance in veterinary medicine continues to increase globally. In the United States, women now account for 81% of 2024 DVM graduates and about 74% of the active workforce (*AVMA*, 2024). In the United Kingdom, the most recent RCVS survey reported that 61% of respondents were female, mirroring registration data and indicating a growing trend (*RCVS*, 2024). At the European level, the FVE survey showed that around 65% of veterinarians are women, with younger cohorts displaying even higher proportions (*FVE*, 2023). This demographic momentum suggests that feminization will continue as older, more male cohorts retire and younger, predominantly female cohorts enter the profession. Despite this clear trend, there is no updated, cross-national causal analysis that explains *why* feminization has occurred or what the future consequences might be for workforce balance, leadership structures, and professional valuation. The most robust causal explanation remains the U.S.-focused study by *Lincoln* (2010), which attributes the feminization largely to supply-side dynamics and the withdrawal of male applicants, rather than wage or tuition effects. Since then, most available studies have been descriptive workforce counts or qualitative discussions on leadership and representation underscoring the need for more systematic, longitudinal, and comparative research (*Vezeau et al.*, 2025).

Additional dimension in assessing the balance between veterinary education outcomes and societal needs is the relationship between the number of veterinarians available and the livestock biomass measured in LSU. Based on the assumption, drawn from the *FVE* (2023) survey, that only 30% of veterinarians are engaged in livestock, equine, and public health practice, we calculated ratio on number of non-companion animal veterinarians/LSU. So, in France, each non-companion veterinarian is responsible for about 3,000 livestock units (LSU). This very high ratio reflects the scale of the national herd relative to available veterinary capacity. In Spain, the figure is lower but still substantial, at around 1,800 LSU per non-companion vet, largely driven by the country's intensive swine and poultry sectors. Germany shows a lighter burden, with



approximately 1,300 LSU per non-companion vet, thanks to its comparatively large veterinary workforce. Italy has the lowest ratio among the four, with about 1,000 LSU per non-companion vet, suggesting relatively more veterinary capacity per LSU.

Our study sample shows that while veterinary workforce size broadly aligns with veterinarian to population ratios reported by the FVE survey (ranging from 0.13 to 0.44 veterinarians per 1,000 inhabitants), the distribution of veterinarians relative to LSU reveals structural imbalances. For example, Serbia, with an estimated 1.7 million LSU, maintains approximately 2,609 veterinarians, of whom fewer than one-third are engaged in food-animal or public-sector roles. This equates to roughly 2,170 LSU per non-companion animal veterinarian. In Slovenia, with a smaller livestock base of ~583,000 LSU, and about 281 non-companion animal veterinarians, study showed lower burden of 2,075 LSU per veterinarian in production and public roles. Bosnia and Herzegovina presents a particularly sharp contrast: despite a total of 756,029 LSU, only about 188 veterinarians are estimated to work in food-animal or public-good domains. This represents nearly 4,000 LSU per veterinarian, indicating a significant service gap. No internationally recognized benchmark exists for an optimal LSU-to-veterinarian ratio. However, our analysis suggests that veterinary coverage for production animals, surveillance, and rural practice is under severe strain, with direct implications for biosecurity, zoonotic disease monitoring, and trade certification. These findings reinforce the argument that current educational and professional pathways trend to channel graduates into companion-animal practice, might keep public-good and production roles systematically under-resourced in long term.

Finally, we identified the several priorities for VEEs to address challenges and issue discussed in this study:

- Broaden professional impact by reinforcing the veterinary profession's capacity to address societal needs beyond companion-animal care.
- Safeguard and expand public-good competencies in food-animal health, veterinary public health, food safety, and One Health.
- Drive curriculum reform to ensure a balanced distribution of learning outcomes across market-oriented and public-good domains.
- Foster regional collaboration in curriculum design, resource pooling, and harmonization of competencies to strengthen workforce resilience.

## 6. Conclusions

The findings of this study confirm a regional structural imbalance in veterinary profession. While training in food-animal medicine remains a core component of existing curricula, the challenge lies in sustaining student interest and ensuring that these pathways remain attractive compared to companion-animal careers. Addressing this requires more than preserving curriculum hours; it demands measures that enhance visibility, engagement, and perceived value of food-animal, public health, and One Health roles. The study demonstrates that VEEs in Southeast Europe operate at the intersection of post-socialist legacies, EU integration, and agri-food trade dependencies. Current accreditation schemes, while ensuring baseline quality and harmonization, risk reinforcing this imbalance. If VEEs align curricula too closely with accreditation indicators and market demand, they may inadvertently follow the companion-animal trend, narrowing their societal contribution instead of broadening it. This context highlights the urgent need for a systematic and strategic approach that recognizes education and the profession as inseparable. VEEs must proactively rebalance training by embedding WOA's public-good competencies alongside EAEVE's standards, ensuring graduates are prepared not only for private practice but also for roles in regulatory services, food safety, and One Health. Demographic shifts, including feminization and attrition pressures, further underline the importance of forward-looking workforce strategies. Regional collaboration—through joint curriculum innovations, shared training infrastructures, and incentive schemes for non-companion-animal careers—offers a practical path forward. While regionally grounded, these lessons resonate more widely: veterinary education should not merely mirror the market or accreditation frameworks but actively shape the profession's capacity to serve as both a responsive service and a public good central to food security, trade, and societal resilience.

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## References

- Angeloni, G., Guardone, L., Buono, N., Lazzaro, E., Ivascu, C. M., Abi, Rizk A., Skordos, D., Prodanov-Radulovic, J., Dimitrova, D., & Nori M. (2023). Mixed human migrations and transboundary animal diseases spread: the Western Balkan route case. 15<sup>th</sup> Epizone Annual Meeting New Perspective for the new Era. Novi Sad, Serbia. <https://repo.niv.ns.ac.rs/xmlui/handle/123456789/656>
- Arnold, E., & Warman, S. (2025). Distributed veterinary education: how can veterinary practices and veterinary schools work together to improve spectrum of care training? *Journal of the American Veterinary Medical Association*, 22, 1–4. <https://avmajournals.avma.org/view/journals/javma/aop/javma.25.07.0451/javma.25.07.0451.xml>
- Australian Veterinary Association, (2025). Destination Thriving: Roadmap for a sustainable veterinary workforce. [https://www.ava.com.au/siteassets/news/white-paper\\_workforce\\_version\\_final3.pdf](https://www.ava.com.au/siteassets/news/white-paper_workforce_version_final3.pdf)
- AVMA, (2024). *Gap shrinks between new graduate, overall veterinary salaries*. <https://www.avma.org/news/gap-shrinks-between-new-graduate-overall-veterinary-salaries>
- Cary, J. A., Farnsworth, C. H., Gay, J., & Carroll, H. S. (2017). Stakeholder expectations regarding the ability of new veterinary graduates to perform various diagnostic and surgical procedures. *Journal of American Veterinary Medical Association*, 251(2), 172–184. DOI: 10.2460/javma.251.2.172. PMID: 28671494.
- Drzemalla, L., Kleinsorgen, C., & Tipold, A. (2025). Clinical training in veterinary medicine: perspectives on quality and the role of specialists. *Frontiers in Veterinary Science*, 12. DOI=10.3389/fvets.2025.1601783
- Diana, A., Mickov, D., van Dobbenburgh, R., Jansen, W., Sternberg, Lewerin, S., Neumann, S., Uldahl, M., & De Briyne, N. (2025). Quo Vadis: Is Corporatization Reshaping Companion Animal Veterinary Care in Europe? *Pets*, 2, 15. <https://www.mdpi.com/2813-9372/2/1/15>
- EAVE, (2023). Standard Operating Procedure (SOP) of the European System of Evaluation of Veterinary Training (ESEVT). [https://www.eave.org/fileadmin/downloads/SOP/ESEVT\\_SOP\\_2023\\_adopted\\_by\\_the\\_36th\\_GA\\_in\\_Leipzig\\_on\\_8\\_June\\_2023.pdf](https://www.eave.org/fileadmin/downloads/SOP/ESEVT_SOP_2023_adopted_by_the_36th_GA_in_Leipzig_on_8_June_2023.pdf)
- Enticott, G., Donaldson, A., Lowe, P., Power, M., Proctor, A., & Wilkinson, K. (2011). The changing role of veterinary expertise in the food chain. *Philosophical Transactions of the Royal Society B Biological Science*, 366 (1573), 1955–1965. Doi: <https://doi.org/10.1098/rstb.2010.0408>
- European Commission, (2009). *Commission Regulation (EC) No 1200/2009 of 30 November 2009 implementing Regulation (EC) No 1166/2008 of the European Parliament and of the Council on farm structure surveys and the survey on agricultural production methods, as regards livestock unit coefficients and definitions of the characteristics*. *Official Journal of the European Union*, L 329, 1–28. <https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:329:0001:0028:EN:PDF>
- European Union, (2005). Directive 2005/36/EC of the European Parliament and of the Council of 7 September 2005 on the recognition of professional qualifications. *Official Journal of the European Union*, L 255. <https://eur-lex.europa.eu/eli/dir/2005/36/oj>
- European Union, (2013). Directive 2013/55/EU of the European Parliament and of the Council of 20 November 2013 amending Directive 2005/36/EC on the recognition of professional qualifications and Regulation (EU) No 1024/2012 on administrative cooperation through the Internal Market Information System ('the IMI Regulation'). *Official Journal of the European Union*, L 354. <https://eur-lex.europa.eu/eli/dir/2013/55/oj/eng>
- ENQA, (2015). Standards and Guidelines for Quality Assurance in the European Higher Education Area (ESG). (2015). Brussels, Belgium. [https://www.enqa.eu/wp-content/uploads/2015/11/ESG\\_2015.pdf](https://www.enqa.eu/wp-content/uploads/2015/11/ESG_2015.pdf)
- Federation of Veterinarians of Europe (FVE), (2023). Survey of the Veterinary profession in Europe. [https://fve.org/cms/wp-content/uploads/FVE-Survey-2023\\_updated-v3.pdf](https://fve.org/cms/wp-content/uploads/FVE-Survey-2023_updated-v3.pdf)
- Fejzić, N., & Šerić-Haračić, S. (2017). Predicting the role of veterinary medicine in future health and food safety challenges. *IOP Conf. Ser.: Earth Environ. Sci.* 85 012004 DOI 10.1088/1755-1315/85/1/012004
- Leighton, F. A. (2004). The Lifeboat Test: A provocative look at veterinary medicine's future. *Canadian Veterinary Journal*, 45(5), 402–404.
- Lincoln, A. E. (2010). *The shifting supply of men and women to occupations: Feminization in veterinary education*. *Social Forces*, 88(5), 1969–1998. <https://doi.org/10.1353/sof.2010.0043>
- National Research Council, (2013). *Workforce Needs in Veterinary Medicine*. Washington, DC: The National Academies Press. <https://doi.org/10.17226/13413>.
- RCVS, (2024). *Survey of the Veterinary Profession 2024*. Royal College of Veterinary Surgeons & Institute for Employment Studies. <https://www.rcvs.org.uk/news-and-views/publications/the-2024-survey-of-the-veterinary-profession-report/?&type=rfst&set=true#cookie-widget>
- Sander, W. E., & Miller, G. Y. (2021). Public practice opportunities for veterinary students to enhance veterinary public health education. *Journal of Veterinary Medical Education*, 48(4), 376–382. <https://utppublishing.com/doi/10.3138/jvme.2019-0076>
- Vezeau, N., Kemelmakher, H., Silva Seixas, J., Ivie, I., Magdy, A., Endacott, I., Amrani, M., Rendina, C., & Wang,

**S. G. (2025).** Characterizing Global Gender Representation in Veterinary Executive Leadership. *Journal of Veterinary Medical Education*, 52(1), 132–138. DOI: 10.3138/jvme-2023-0092

**World Organization for Animal Health, (2012).** OIE recommendations on the Competencies of graduating veterinarians ('Day 1 graduates') to assure National

Veterinary Services of quality. <https://www.woah.org/app/uploads/2021/03/dayone-b-ang-vc.pdf>

**Zoetis, 2025.** Transforming veterinary practice for 21<sup>st</sup> century. [https://www2.zoetis.co.uk/content/\\_assets/ZOETIS\\_White-paper\\_Transforming-Veterinary-Practice-for-the-21st-Century.pdf?utm\\_source=chatgpt.com](https://www2.zoetis.co.uk/content/_assets/ZOETIS_White-paper_Transforming-Veterinary-Practice-for-the-21st-Century.pdf?utm_source=chatgpt.com)

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