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Veterinary pharmacy: coverage in the undergraduate pharmacy curriculum and perspectives of practising pharmacists

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Abstract

Background: The scope of tuition delivered in a School of Pharmacy in the UK on the topic of veterinary pharmacy appears to be centred on legislation and medicine supply under the veterinary cascade.

Aims: This study sought the opinions of pharmacy undergraduate students, practising community and hospital pharmacists, on veterinary pharmacy in the current undergraduate curriculum and their views on increasing coverage of this topic.

Method: Data were collected through use of survey questionnaires, focus groups and direct face-to-face structured interviews from 115 pharmacy students, 40 community pharmacists and 20 hospital pharmacists.

Results: Findings from this study confirmed that veterinary pharmacy coverage is minimal in the current undergraduate pharmacy curriculum. About 70% of student respondents confirmed that greater inclusion of veterinary pharmacy in the curriculum is perceived to be beneficial for future employment. Community pharmacists revealed that their lack of knowledge of veterinary medicines affected their participation in veterinary pharmacy. Though hospital pharmacists were not exposed to, and rarely had any participation in veterinary pharmacy, they were largely of the opinion that all pharmacists should possess knowledge of veterinary medicines.

Conclusions: The main conclusion is the current level of tuition on veterinary pharmacy is insufficient and this identified deficiency requires to be addressed.

Keywords: *veterinary pharmacy, undergraduate pharmacy curriculum, postgraduate pharmacy education, pharmacy practitioners*

Introduction

Historically, veterinary surgeons have diagnosed diseases and conditions adversely affecting animal health, subsequently prescribing for the condition to restore optimum health to their patients (Ceresia *et al.,* 2009). Traditionally the role of pharmacists in veterinary pharmacy was the dispensing and compounding of prescribed medicines for animal use (Karriker & Weibe, 2006; Ceresia *et al*., 2009). Regardless of whether pharmacists dispense for human or animal patients the duty of care of pharmacists with regard to both patient groups is identical. Of the 45,466 pharmacists currently registered in the UK (S. Smith, General Pharmaceutical Council [GPhC], personal communication, 12th November, 2012) the majority would appear not to possess sufficient knowledge of veterinary medicines to dispense veterinary prescriptions (Kirby, 2005; O'Driscoll *et al.,* 2014). Research has also shown that few pharmacies in the United Kingdom (UK) stock veterinary medicines (Evans, 2011). Several pharmacists who participated in this study however, confirmed familiarity with the supply of medicines via the veterinary cascade. The veterinary cascade refers to a clause in the Veterinary Medicines Regulations permitting treatment by a veterinary surgeon of an animal in their care with unauthorised medicines (Veterinary Medicines Directorate [VMD] 2013). The stipulation is, and requires, that no suitable veterinary medicine is licensed for treatment of that animal species in the UK, and that a specific prescribing sequence is observed in the following descending order of priority:

- a veterinary medicine licensed in the UK for the treatment of a different animal species or for a different condition in the same species;
- in the absence of such a product, a human medicine licensed for use in the UK or a veterinary medicinal product licensed for any animal treatment in a European Union Member state may be prescribed;
- the final option should no product be available, is the extemporaneous preparation of a product by a veterinary surgeon, a pharmacist or the holder of an appropriate marketing authorisation. The importation of medicines from Third World countries is permitted in exceptional circumstances (VMD, 2013).

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The GPhC has identified one of the outcomes for the initial training and education of pharmacists in the UK as the ability to supply human and veterinary medicines safely, efficiently, whilst also conforming to current legal requirements and best professional practice (GPhC, 2012). In line with the GPhC's requirement, the authors sought to review whether a typical School of Pharmacy is currently delivering the core information and skill sets to pharmacy students that they will require as future practising pharmacists, in order to fulfil this requirement with regard to veterinary medicine.

Research Aim

This study sought to determine views of pharmacy students', community and hospital pharmacists' on the provision of veterinary pharmacy education within contemporary undergraduate pharmacy education.

Methods

Ethical approval for this work was granted by the School of Pharmacy and Life Sciences Research Ethics Committee of the Robert Gordon University, Aberdeen. The study was conducted using a mixed methods research approach. After piloting these methods, minor alterations were completed and data were collected via survey questionnaires, focus groups and direct face-to-face structured interviews, regarding the opinions and interest of pharmacy students and practising pharmacists towards the knowledge and practise of veterinary pharmacy. Data for undergraduate pharmacy students was collected during semester teaching periods from November 2011 – December 2012, while practising pharmacists were polled by questionnaire, focus groups and face-to-face interviews between May – September 2012. Data, whether digital or hard copy, was stored securely after collection and during the data extraction process. Data was manually extracted from the completed questionnaires and independently checked before tabulation.

Some of the questions posed to the students and pharmacist groups were the same, while other questions were tailored according to their professional status (Appendix 1).

Participants

The sampling approach was purposive and the population consisted of 115 pharmacy students (75 third-year and 40 final-year) at a UK School of Pharmacy, both class cohorts selected by general invitation to participate. For current practitioners, 20 Scottish hospital pharmacists, 20 Scottish community pharmacists and 20 Irish community pharmacists were included after selection by invitation to participate. The community pharmacists were from a mixture of rural and semi-urban practices.

Results

1. Undergraduate MPharm Students

Students' awareness of veterinary medicine

All student respondents possessed an awareness of veterinary pharmacy; however, several commented they had undertaken self-motivated searches for information on veterinary medicines to enhance future employment prospects as veterinary pharmacists. Some students commented that they did not know where to go to get information on opportunities or expert information on veterinary pharmacy.

"I am very interested in the area of Veterinary Pharmacy but I have been unable to find information on the opportunities in this area and have struggled to find anyone knowledgeable in the subject".

Information on veterinary medicines received as undergraduate students

Figure 1a showed similar numbers of third and fourth-year students (approximately 80%) who reported that they had received some tuition on veterinary pharmacy. This information was limited to veterinary legislation and the veterinary cascade, delivered during the second year of their four-year undergraduate course. Approximately one fifth of student respondents stated they had received no information at all on veterinary medicines.

As undergraduates, would they have welcomed more information on veterinary pharmacy during the MPharm course?

Approximately 60% of third-year students agreed they would have welcomed further information on veterinary medicines, whereas 76% of fourth-year respondents stated their desire for further information on veterinary pharmacy (Figure 1b).

"Quite a specialist area but I think all pharmacists could do with a basic grounding in it. As in community pharmacy eardrops and flea medication is sold. And in hospital medicine intended for animals is occasionally used when no human formulation is available."

Observation of pharmaceutical practice prompted student comments regarding sub-standard provision and controls of veterinary pharmacy they witnessed;

"Currently not covered and is an area with below adequate pharmaceutical standards. Drugs can be freely acquired, only have to ask, poor understanding of effects by the person using pharmaceuticals in veterinary …….No guidance on administration in a commercial sense".

Would they select veterinary pharmacy as a study topic if provided with elective modules?

Forty-eight percent (48%) of third-year students compared to 78% of fourth-year students would elect to study veterinary pharmacy if given a choice of study areas (Figure 1c).

Whether they considered possessing information on veterinary pharmacy would expand their career opportunities?

Almost 80% of fourth-year students but only 45% of third-year students, thought knowledge of veterinary pharmacy would offer them wider career opportunities as pharmacists (Figure 1d).

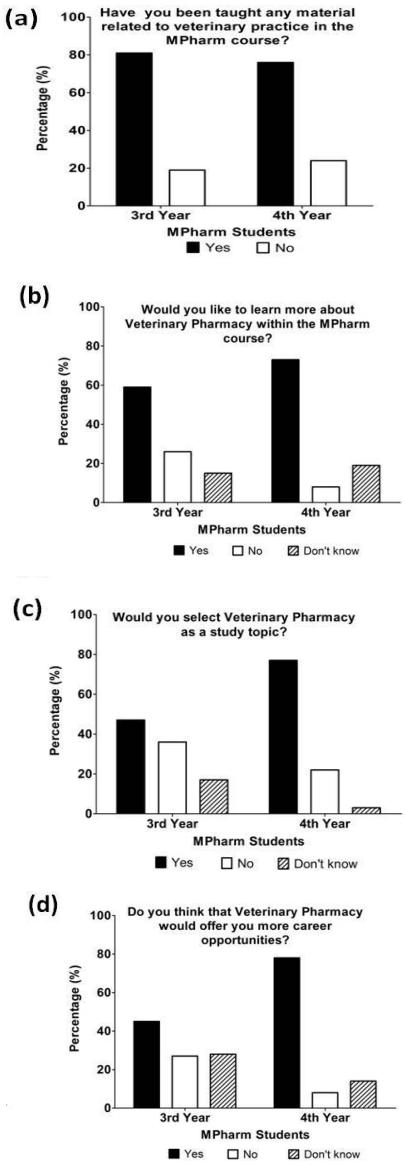
"I think it would be a very good idea to offer options to students. Veterinary could be an option depending on what students want to do as a career..."

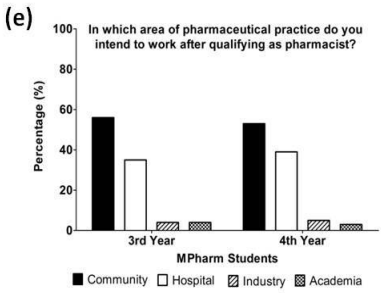
"It is an area of pharmacy that I would be very interested in, especially coming from a farming background. However it may not be something that would appeal to everyone. I would agree that it would definitely be a good idea to introduce it into the MPharm programme however. It would make the course much more rounded."

The area of pharmaceutical practice they wished to enter after qualifying as pharmacists

Responses to this question elicited similar numbers of third and fourth-year students choosing community pharmacy (approximately 60%) as first choice with hospital pharmacy in second place (approximately 40%), with less than 5% selecting other career options (Figure 1e). In focus groups third and fourth-year students commented, that they had not considered or been aware of career opportunities in veterinary pharmacy.

Figure 1: Responses of MPharm undergraduates





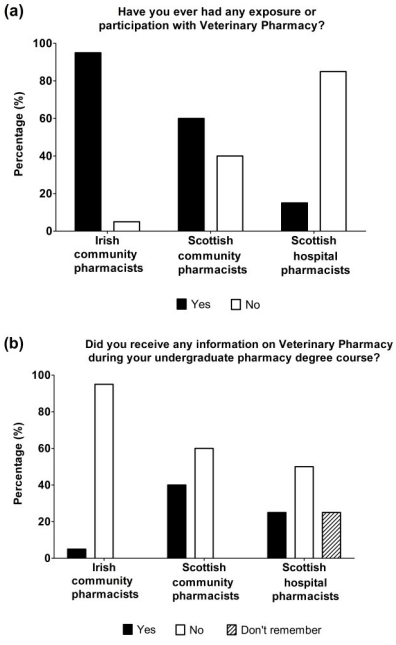
2. Practising Pharmacists

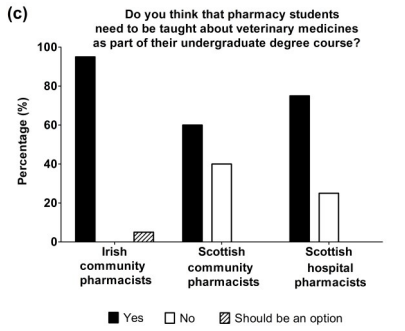
Community Pharmacists exposure/participation with veterinary pharmacy

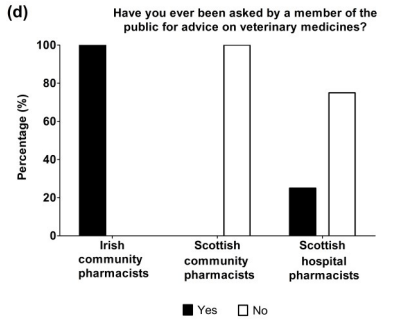
Ninety per cent (90%) of Irish community pharmacists, compared to only 60% of Scottish pharmacists and 15% of hospital pharmacists (Figure 2a) were aware of, and involved in, veterinary pharmacy. The exposure/participation with veterinary medicines occurred either through dispensing veterinary prescriptions or selling over-the-counter (OTC) veterinary medicines to members of the public. The hospital pharmacists' exposure/participation mainly occurred through occasional locums undertaken in community pharmacy, though a very small proportion had dispensed veterinary medicines to human patients in their hospital roles. Although all the pharmacists interviewed in hospital locations identified themselves as hospital pharmacists, their sphere of practice was not limited to one area of professional practice (Figures 2a/d/e).

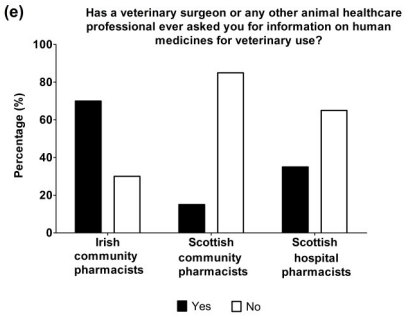
"I like animals and would like to get involved in veterinary pharmacy but I cannot see how pharmacists could compete against the vets and co-ops as we don't have the knowledge, training or familiarity with veterinary medicines or animals as it's not an area that we learn anything about during our training as pharmacists".

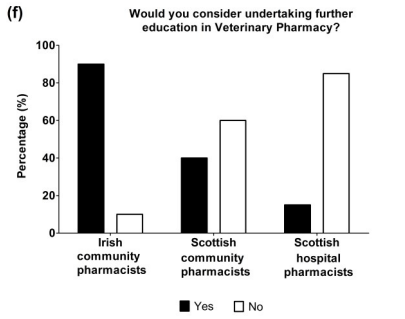
Figure 2: Irish, Scottish and Hospital Pharmacists' responses











Information on veterinary medicines received by pharmacists when studying as undergraduate students

The majority of Irish pharmacists (90%) had not received any information on veterinary pharmacy as undergraduate students, whereas 40% of Scottish pharmacists had been taught some aspects of veterinary pharmacy as undergraduates (Figure 2b). Half of the hospital pharmacists stated they had not received any education in veterinary pharmacy; with 25% admitting they could not recollect, as they had earned their degrees two or more decades previously (Figure 2b). The remaining 25% of the hospital pharmacists had received information on veterinary pharmacy as undergraduates but as with the Scottish community pharmacists, this information was limited to facts on legislation and the veterinary cascade.

Should information on veterinary medicines be delivered to undergraduate students?

All the respondent Irish community pharmacists thought information on veterinary medicines should form part of the undergraduate curriculum (Figure 2c). The responses of the Scottish pharmacists revealed divided opinions on this subject, with 40% responding it was not necessary to incorporate veterinary pharmacy in the undergraduate syllabus, as they perceived this as a speciality area better addressed by optional postgraduate study (Figure 2c).

"This is a growing part of pharmacy and an important part in cities for small animals therefore some knowledge of veterinary pharmacy is valuable to pharmacists".

"Although in my experience it is a rare occurrence having to deal with veterinary medicines, these should be equally as important as other common aspects of pharmacy".

Three-quarters (75%) of hospital pharmacists felt that veterinary pharmacy should be included in the undergraduate pharmacy syllabus (Figure 2c). The remaining 25% were of the opinion the topic was a specialised area and should be the domain of postgraduate education, with the undergraduate focused on human pharmacy.

"If I was going to get involved in animal medicines however I would have to find and undertake further education in this area as I have no experience dealing with animals and it was not studied when I was a pharmacy student".

Advising the public on veterinary medicines?

All the Irish community pharmacist participants confirmed a member of the public had approached them for advice on the correct use of veterinary medicines (Figure 2d). These respondent pharmacists revealed not all the pharmacies where they were employed stocked veterinary medicines; either due to local agricultural merchants or veterinary surgeries supplying the veterinary medicine market in their area.

The Scottish community pharmacists' revealed a contrasting situation to the Irish pharmacists' experience, as no member of the public had approached any of the Scottish respondents for information on veterinary medicines (Figure 2d). Although only 15% of the hospital pharmacists' revealed exposure/participation with veterinary pharmacy, 25% stated a member of the public had asked them for advice on veterinary medicines. This would seem to suggest that people in certain areas of Scotland also on occasion visit pharmacies, whether or not they stock veterinary medicines, for advice on the correct use of veterinary medicines.

Pharmacists also rely on the veterinary surgeon's expertise regarding the dose and frequency of treatment as they are neither aware of nor have access to veterinary reference sources as a check system;

"I don't have any involvement with veterinary pharmacy because I know very little about animals and I don't have enough information or knowledge to advise people about veterinary medicines".

"I wish I knew more about veterinary pharmacy, especially some way of checking animal doses on prescriptions. If I dispense a veterinary prescription I am not at all happy as I rely that the vet has prescribed the correct dose and frequency of the prescribed medicine as I have no way of checking if it's correct or not".

Comments from pharmacists, who were familiar with veterinary medicine through prior exposure, reveal a different type of pharmacy practice:

"I enjoy veterinary pharmacy but I was lucky as I come from a farming background and I absorbed a lot of information about animals and their treatment when I was growing up and I am used to dealing with animals whereas I know most pharmacists wouldn't be familiar with the different breeds of cattle and their ailments or how to handle animals".

"My pharmacy business is mostly veterinary based. My father always stocked veterinary medicines and built up a reputation as being a pharmacist knowledgeable on veterinary medicines and I continued on from him but if I didn't have him to "train me in" I would not have felt comfortable dispensing or advising people on what or how to administer drugs to their animals as I received no training in veterinary pharmacy as an undergraduate student".

Advice to other healthcare professionals

About 70% of the Irish respondents revealed they had been approached by either a veterinary surgeon or another animal healthcare professional for advice on administering human medicines to animals (Figure 2e). Fifteen percent of Scottish respondents stated animal healthcare professionals had approached them on the correct use of human medicines in animal welfare, 35% of hospital pharmacists' respondents had been asked by a veterinary healthcare professional for information regarding the use of human medicines for animal use (Figure 2e).

Would you consider undertaking further education in Veterinary Pharmacy

Almost all of the Irish community pharmacists (Figure 2f) indicated their interest in undertaking further education in veterinary pharmacy. Only 40% of Scottish community pharmacists and 15% of hospital pharmacists expressed willingness (Figure 2f).

Opinions of Pharmacists

Three-quarters (75%) of the respondents believed veterinary pharmacy should form part of the undergraduate curriculum (Figure 2c) and the large numbers of opinions provided by the participants reflect this:

"Pharmacists need to be educated in veterinary pharmacy to broaden opportunities and allow a specialist career option".

"Pharmacy students should be taught veterinary medicines just in case they get prescriptions even at non-veterinary pharmacies".

Fifteen percent of the polled hospital pharmacists have had exposure/participation with veterinary pharmacy, primarily through locum work in community pharmacies (Figures 2a/d/e). The necessity of relevant resources to confirm doses and check drug contra-indications for various species was one of the comments made by several pharmacists, as they were not aware where such information could be sourced and would have made use of them on several occasions had they known;

"Pharmacists need to know what can and can't be prescribed. Would also be useful to know what resources to use to confirm doses etc".

"Pharmacy students need to be taught ….legal aspects of dispensing human medicines for veterinary use – at least expose students to reference sources".

Although some hospital pharmacists were of the opinion that veterinary pharmacy was an under-developed area of pharmacy practice, the following demonstrates that many of this group held very different opinions:

"I think veterinary medicine is a complete waste of pharmacist's time. Anyway it's a closed shop as the vets' control all medicines for animals as well as dispensing their own prescriptions and pharmacists don't get a look in".

"I think it's a specialist subject that needs to be taught if a pharmacist specialises in that area. There is enough human clinical pharmacy to learn at undergraduate level".

Discussion

The judicious use of medicines is continually under scrutiny, in particular antimicrobial agents due to the rise in resistance and the emergence of multidrug resistant organisms (Finch & Hunter, 2006; Falagas & Bliziotis, 2007; Cushnie & Lamb, 2011). This has focussed attention on pharmaceutical care of animals and the appreciation that both humans and animals receive treatment with identical medicines from medical and veterinary practitioners respectively. Effective professional interaction and consultation between medical practitioners and veterinary surgeons on prescribing protocols for licensed medicines for both animal and human treatment remain to be developed. Pharmacists and medics have developed mutually beneficial roles in the practice of human medicine and similar inter-professional development could be fostered between veterinary surgeons and pharmacists. Pharmacists are uniquely placed to promote the future possibility of all medicine use and development without differentiation in species treatment. In some cases the effects of medicine usage in one species also impacts on effective treatment for the other; for example use of the antibacterial colistin is restricted for multidrug resistant infections in humans (Zavascki *et al.,* 2007; Nation & Li, 2009; Falagas & Rafailidis, 2009), yet widespread usage in animals (particularly pigs and poultry) has been commonplace over the past decade. This will inevitably enhance development and spread of resistance to this antibiotic culminating in treatment failure for human patients (O'Driscoll *et al.,* 2014). Perhaps it is opportune that a recent initiative has been launched for the development of One Health Initiative: One World, One Medicine, One Health as opposed to the current separate existence of human and animal

medicine (Blythe Lust, 2009; One-health Wonders, 2009; O'Driscoll *et al.,* 2014).

The aim of this research was to determine the views of student and practising pharmacists on the delivery of veterinary pharmacy education in a current pharmacy degree course.

Analysis of the information obtained from undergraduates clearly shows that students are familiar with veterinary pharmacy but received little information on this area of pharmacy during their studies. The majority of the student respondents agreed they would select veterinary pharmacy as a study topic if given the option and they considered possessing knowledge of veterinary pharmacy as potentially enhancing their future employability as pharmacists. As the greater proportion of these prospective pharmacists selected community pharmacy as their future preferred area of practice, exposure to veterinary pharmacy perhaps through contact with companion animal owners or members of the farming community is a distinct possibility.

Lack of knowledge of veterinary pharmacy was one over-riding theme that became apparent from analysing the completed questionnaires. Although the majority of students agreed they would have welcomed receiving more information on veterinary pharmacy whilst undertaking the MPharm course, a lack of suitable knowledge of what comprised veterinary pharmacy prevented a substantial proportion of students from making a decision for or against further participation in this area of pharmacy practice. Despite these concerns, students felt the undergraduate pharmacy degree would be more balanced if they were to receive information on both human and veterinary medicines. A limitation of this study is that only students attending one UK School of Pharmacy were polled and the views these students expressed may not necessarily be those of other groups of undergraduate pharmacy students. Another study limitation was that the response rate of third-year students was 67% compared to 80% of fourth-years.

All the respondent Irish pharmacists supported the inclusion of information on veterinary medicine in the undergraduate pharmacy curriculum. These pharmacists revealed that members of the public had approached them for advice on veterinary medicines in their professional capacity and the majority of this group had been consulted by either veterinary surgeons or other animal healthcare professional for advice on the use of human medicines in animals. A willingness to undertake further postgraduate education in veterinary pharmacy was also expressed by the majority of Irish pharmacists, while their Scottish counterparts currently remain less interested in undertaking further education in this area. Scottish pharmacists made many comments that veterinary pharmacy is a specialised area, knowledge of which they considered better suited to postgraduate education.

Elective courses in veterinary pharmacy, together with continuing education for practising pharmacists, have been offered by certain US Schools of Pharmacy for some years (Lust, 2003; O'Driscoll *et al.,* 2014). The focus of these courses is largely legal/regulatory issues and on veterinary therapeutics (Lust, 2003); however, this type of educational provision is still a developing area (Ceresia *et al.,* 2009).

Postgraduate courses in veterinary pharmacy are also available, for example the Royal Pharmaceutical Society of Great Britain approved postgraduate diploma in veterinary pharmacy offered by Harper Adams University (Harper Adams University, 2012). The University of Florida also offers an online course in veterinary therapeutics for practicing pharmacists (University of Florida, 2013).

Generally lack of knowledge was the constantly occurring reason given for the prevention of most pharmacists from getting involved or participating in veterinary pharmacy. Also apparent was that pharmacists learned experientially about veterinary medicines with little prior formally taught knowledge. This experience was gained whilst engaged in carrying out their professional roles, often when interacting with a knowledgeable colleague. This situation is not unique to the UK as research undertaken in the US some years ago also revealed pharmacists acquired knowledge of veterinary medicines through such practices (Kariker & Wiebe, 2006).

It was seen from the information provided by hospital pharmacists that fluidity exists in pharmacists' roles, and although being employed full-time as a hospital pharmacist, they also on occasion can practice as community pharmacists. Moreover, hospital pharmacists also revealed that they neither have interest in veterinary medicine nor feel that veterinary surgeons would welcome participation of pharmacists in veterinary medicine. Yet, hospital pharmacists reported that members of the public had approached them for advice on veterinary medicines and veterinary healthcare professionals had consulted one third of those polled on the use of human medicines in animal treatment. Therefore, the greater majority of these hospital pharmacists considered information on veterinary medicines should be delivered to undergraduate pharmacy students.

It is necessary to comment that the number of pharmacists polled in this study was small which will limit a broader consensus being identified. To address this deficiency a follow on research study involving a much larger group of pharmacists is in the process of being undertaken.

Whilst acknowledging the sample size of pharmacists participating in this study was relatively small, the views expressed were those of currently practising pharmacists in two European Union states. Inclusion of veterinary pharmacy in the undergraduate pharmacy curriculum was in their opinion a potential benefit to the practice of future pharmacists. Perceptions of veterinary pharmacy as a speciality subject could be diminished through the provision of information on the correct dispensing, therapeutic delivery, formulation and administration of veterinary medicines in the indicative MPharm syllabus. The future implication of such education in veterinary medicines could lead to the recognition of all pharmacists as experts in all medicine and not solely those medicines for human use and would promote the One Health Initiative: One World, One Medicine, One Health .

Conclusion

Drawing on the sound principles of constructive alignment and the need to meet all stakeholders' needs (practitioners, public, government, *etc*.) the authors recommend re-evaluation of the current material on veterinary pharmacy within the undergraduate MPharm degree provision. This would ensure the curriculum complies with the GPhC identified outcomes. In addition, further specialist

postgraduate courses in veterinary pharmacy should be made available to pharmacists wishing to specialise in this area. Continuing professional development courses in veterinary pharmacy should be developed for practising pharmacists, to address the lack of teaching on veterinary medicines during their initial training and education.

Declaration of interest

The authors have no conflict of interest. The authors alone are responsible for the content and writing of the article and the views contained within.

References

Blythe Lust, E. (2009). A lecture About Pharmaceuticals Used in Animal Patients. *American Journal of Pharmaceutical Education,* **73**(7), Article 116.

Ceresia, M.L., Fasser, C.E., Rush, J.E., Scheife, R.T., Orcutt, C.J., Michalski, D.L., Mazan, M.R., Dorsey, M.T. & Bernardi, S.P. (2009). The Role and Education of the Veterinary Pharmacist. *American Journal of Pharmaceutical Education,* **73**(1), Article 16, 1-9.

Cushnie, T.P. & Lamb, A.J. (2011). Recent advances in understanding the antibacterial properties of flavonoids. *International Journal of Antimicrobial Agents,* **38**(2), 99-107.

Evans, A. (2011). Veterinary medicines – a not-to-be missed opportunity for pharmacy. *The Pharmaceutical Journal,* **286**: 339.

Falagas, M.E. & Bliziotis, I.A. (2007). Pandrug-resistant Gram-negative bacteria: the dawn of the post-antibiotic era? *International Journal of Antimicrobial Agents*, **29**(6), 630-636.

Falagas, M.E. & Rafailidis, P.I. (2009). Nephrotoxicity of colistin: new insight into an old antibiotic. *Clinical Infectious Diseases*, **48**(12), 1729-1731.

Finch, R. & Hunter, P.A. (2006). Antibiotic resistance-action to promote new technologies: report of an EU Intergovernmental Conference - Birmingham UK, 12-13 December, 2005. *Journal of Antimicrobial Chemotherapy*, **58**(S1), i3-i22.

General Pharmaceutical Council. (2012). Future pharmacists. Standards for the initial education and training of pharmacists.

Harper Adams University. (2012). Postgraduate diploma in veterinary pharmacy (online). Available at: http://www.harper-adams.ac.uk/study/. Accessed 27th November, 2012.

Karriker, M. & Wiebe, V. (2006). Pharmacists in Veterinary Education: Bridging the Gap. *Journal of Veterinary Medical Education,* **33**(2), 248-252.

Kirby, J. (2005). Pharmacists must not overlook the opportunities on offer in animal health. *Tomorrow's Pharmacist,* **2005:56**.

Lust, E. (2003). Educational outcomes in Vet 101; A continuing education course for practicing pharmacists in veterinary therapeutics. *Pharmacy Education*, **3**: 237-247.

Nation, R.L. & Li, J. (2009). Colistin in the 21st century. *Current Opinion in Infectious Diseases,* **22**(6), 535-543.

O'Driscoll, N.H, Juwah, C., Labovitiadi, O. & Lamb, A.J. (2014). Veterinary pharmacy within the UK: Review of current practice and education. *Pharmacy Education*, **14**(1), 26-30.

One-health Wonders. (2009). Available at: http://www.avma.org/onlnews/javma/may09/090515w.asp. Accessed 23rd July, 2012.

University of Florida. (2013). Veterinary Therapeutics for Practicing Pharmacists: Continuing Pharmacy Education (online). Available at: http://cpe.pharmacy.ufl.edu/courses/certificate/vettherapeutics/. Accessed 27th November, 2013.

Veterinary Medicines Directorate. (2013). Veterinary Medicines Advice for Pharmacists (online). Available at: www.vmd.defra.gov.uk/vet/cascade.aspx. Accessed 27th November, 2012.

Zavascki, A.P., Goldani, L.Z., Li, J. & Nation, R.L. (2007). Polymyxin B for the treatment of multidrug-resistant pathogens: a critical review. *The Journal of Antimicrobial Chemotherapy*, **60**(6), 1206-1215.

Appendix 1

Questions: Student groups

- Awareness of veterinary medicine
- Whether they had received any information on veterinary medicines during their undergraduate studies to date.
- Whether they would have welcomed any further information on veterinary pharmacy as undergraduate pharmacy students.
- The future area of pharmaceutical practice – to gauge the possibility of exposure to animal patients.
- Whether they considered possessing information on veterinary pharmacy would expand their career opportunities.

Questions: Hospital and Community Pharmacists

- Awareness of veterinary medicine
- Whether they had received any information on veterinary medicines during their undergraduate pharmacy degree course.
- Whether they thought current undergraduates need to be taught about veterinary medicine within their course.
- Whether a veterinary surgeon or other animal healthcare professional had ever consulted them for information on human medicines for veterinary use.
- Whether a member of the public had asked them for advice on veterinary medicines.
- Whether they would consider undertaking further education in veterinary medicine.