Why the contextualisation of chemistry in the MPharm curriculum is needed

Chemistry is a subject that underpins pharmacy. Suzanne Fergus and Andrzej Kostrzewski explain how the contextualisation of chemistry effectively integrates it with pharmacy practice.

Chemistry is a core subject area in the MPharm degree programme. The indicative syllabus specifies chemistry directly in drug design and discovery, pharmaceutical chemistry and analysis, drug identification and drug synthesis. Without a solid chemistry foundation, pharmacy students are unable to integrate the pharmaceutical importance of drug structures, drug interactions and side effects fully, which is critical in terms of ensuring patient safety.

The General Pharmaceutical Council’s education standards for initial education and training of pharmacists will drive future MPharm curriculum development in all UK schools of pharmacy. These standards will each have an individual set of associated criteria and also require evidence from a training provider to demonstrate that the standards have been met to a satisfactory level. In the area of curriculum development, it will be important to structure learning opportunities in order to provide an integrated experience of relevant science and pharmacy practice.

So, how can schools of pharmacy integrate science with pharmacy practice, particularly in the first year of the MPharm? This concept was considered during the design of the MPharm curriculum at the School of Pharmacy, University of Hertfordshire, resulting in the integration of science and pharmacy practice between modules in a year of study (horizontal integration) and linking modules of different years of study (vertical integration). Chemistry is a subject that underpins pharmacy and this article will outline how the contextualisation of chemistry (and science in the broader sense) effectively integrates it with pharmacy practice.

Contextualisation of chemistry

Contextualisation is the use of real-life applications as a starting point to introduce or study a scientific concept. Contextualisation helps to answer the “why?”: why this is relevant and why one should learn this information. It is easier to contextualise chemistry in later years of the MPharm because topics relating to drug discovery and specific therapeutic areas have been covered. However, this approach is essential right from the start in order to ensure students integrate and apply scientific principles to clinical approaches. Within a chosen therapeutic area, the chemical concepts underpin the safe and effective use of specific medicines and this overlaps with the relevant clinical advice from a pharmacist.

An example of how scientific principles are central to patient safety is illustrated below, where drugs derived from a natural product source are available as cheaper alternatives to other illegal recreational drugs.

Mephedrone

Khat is an evergreen tree or shrub found in a region extending from southern Africa to the Arabian Peninsula. In these parts, chewing fresh khat leaves is a common tradition resulting in effects that include euphoria, excitement, anorexia, increased respiration, hyperthermia, logorrhoea, analgesia and increased sensory stimulation similar to those observed with amphetamine.

The major active alkaloid constituent in fresh khat is S-(-)-cathinone. Cathinones are analogues of amphetamines (see Figure below). Due to its high lipid solubility, this facilitates access of the molecule into the central nervous system, accounting for the induced psychostimulation. The major metabolites of cathinone — cathine and norephedrine — are less lipophilic and possess weaker central stimulant properties. Synthetic derivatives of cathinones have produced psychoactive substances. One such derivative that received immense media attention during 2010 is mephedrone (4-methylmethcathinone).

The National Addiction Centre in London reported mephedrone as the sixth most popular drug among clubbers after tobacco, alcohol, cannabis, ecstasy and cocaine.

The Advisory Council on the Misuse of Drugs published a report on the cathinone derivatives and mephedrone was classified as a Controlled Drug (class B) on 16 April 2010. Before its ban, many people considered mephedrone not to be harmful because of its appealing legal status.

The structure of mephedrone contains a single chiral centre, resulting in two enantiomeric forms, S- and R-mephedrone. For cathinone, the S-(-)enantiomer is more potent than the R-(-)enantiomer and this may be similar in the case of mephedrone.

The major concern in terms of patient safety is that little is known about the pharmacology of mephedrone. It is expected to act as a central nervous system stimulant by promoting the release of monoamine neurotransmitters and likely inhibiting their reuptake.

Cathinones similar to amphetamines bind to noradrenaline, dopamine and serotonin transporters, but with a different relative binding potency. The potency of cathinones is mainly lower than that of amphetamines. This, again, is explained from their chemical structure as the beta-keto moiety imparts a...
reduced ability to cross the blood-brain barrier.5 It is evidently clear that the strong interdependent relationship between science and clinical practice is crucial in order to assist healthcare professionals to address the current issue of legal highs and ensure effective understanding of this phenomenon.

Case study approach
Case studies have been used in the teaching of chemistry with first-year undergraduate pharmacy students at the University of Hertfordshire. A contextualised case study on antihistamines was presented to year 1 students. The students discussed the topic in small groups, followed by a general discussion of the case study:

A taxi driver comes into the pharmacy with seasonal allergies. He asks for advice on what to take and needs an antihistamine that will not cause drowsiness for his job. You have Benadryl One A Day (cetirizine) and Piriton (chlorphenamine) as your options.

- Provide a rationale for your choice, considering the chemical structures of both choices.
- Considering the structural features of cetirizine and chlorphenamine, where (stomach or intestine) will each drug be best absorbed?
- What other treatments are available for seasonal allergies, taking into account the routes of administration?

Feedback from the students included:

Case studies help relate the chemistry with real life situations including medicines and drugs.

I found it useful as you are able to apply your knowledge.

It’s best if theoretical learning is linked directly to everyday life events. Makes it clearer and much more understandable.

It allows you to develop a better understanding of chemistry because you get to see why we study it.

It’s so much easier to learn chemistry when it’s made directly relevant to our future careers.

This has been positive in terms of student learning and it enables students to apply problem-solving skills to a real-life situation.

Education standards
The Panel above illustrates the items from the GPhC’s indicative syllabus1 used for UK pharmacy degree courses, which are covered by the contextualised model of teaching and learning. The model for contextualisation of chemistry in pharmacy presented demonstrates a pathway to the successful integration of science and pharmacy practice in accordance with the GPhC’s education standards. It is necessary to foster this approach of science and pharmacy practice integration from year 1 so that our future pharmacists “know” and “know how” to link both aspects from an early stage in their careers, building towards the “show how” and “do” levels of competency. This holistic approach to learning will benefit patient care and strengthen the education training of future pharmacists.

References