To pee or not to pee? A urine-free renal practical

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Introduction

- When providing practical classes for large, diverse groups, it can be challenging to provide enough equipment and resource to give every student an excellent 'hands on' practical experience.
- One of the issues experienced in recent years in our institution has been a rapid and large increase in students undertaking fundamental physiology courses. Many of these students may not actually be reading for a degree in medically-related sciences.
- In addition, concern was raised about health and safety or ethical concerns during human-based practicals now that we had such large student numbers.
- Turnover in teaching laboratory technical staff and a high occupancy rate for our teaching lab facilities also meant that it would be more efficient if practicals could be developed that could be supported by different members of technical staff of different academic disciplines, and if preparation and clear-up could be made more efficient (see Figure 1).

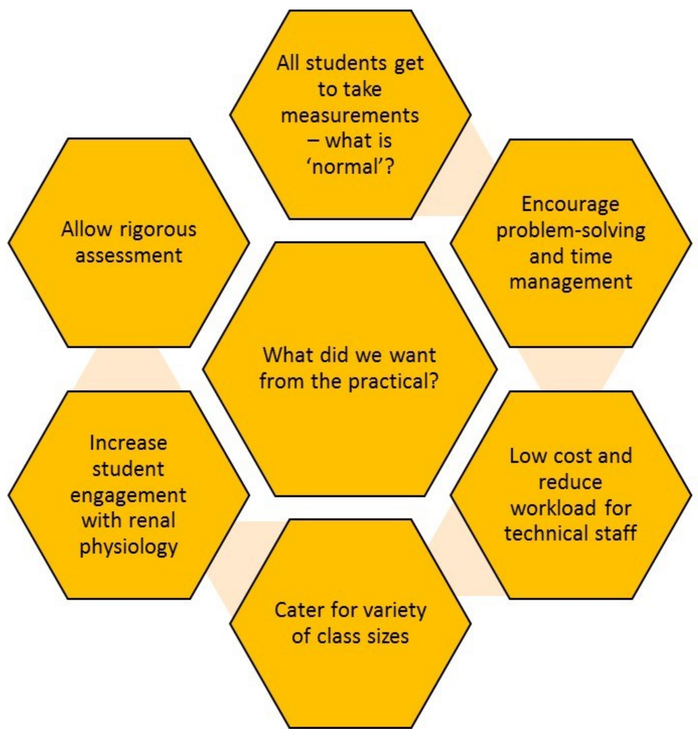

Figure 1. Information that students are given regarding samples that have been gathered from volunteers or 'patients'. Students then have to work out which sample came from which individual. We wanted samples that allowed students to demonstrate their understanding of fundamental renal physiology, acid-base status, osmolarity and integrative physiology.

- We aimed to develop a new renal physiology practical that utilised artificial urine samples that would still allow students to undertake accurate analysis, improve their understanding of the topic, and also allow us to rigorously assess the students in large groups (e.g. > 200 students).

Methods

- Six samples produced using a variety of salt solutions and food colouring to mirror experimental samples obtained from real human specimens.
- Students in groups of 2 or 3 are allocated their randomly-coded pots of urine to test.
- Chemical dipstix used to provide initial rough idea of pH and to test for presence of protein, glucose, blood etc.
- Osmolarity of each sample measured by students with freezing point osmometers (values can be provided if osmometer not available).
- Students identify which sample came from which volunteer or patient.
- During the practical, students also have problem-solving questions to work through so that students are always engaged with relevant material to improve their understanding of renal physiology.

Figure 2. Freezing point osmometer. We have two of these stationed around the lab so that students can accurately measure osmolality. The osmometers may alos be staffed by a demonstrator or member of technical staff who can talk to small groups of students about the importance of accuracy and calibration. If a lab has no access to an osmometer, values can be provided for the students and they can still work out which sample came from which person.

Results

Control/Normal	Subject drank 100 ml of H_2O and rested quietly
Water Diuresis	Subject drank 1 litre of H_2O and rested quietly
Water & Exercise	Subject drank 1 litre of H_2O and after 30 min exercised for 30 min at moderate intensity
Furosemide Ingestion	Subject took one 20 mg tablet of the loop diuretic, furosemide
Acidosis	Either sample came from patient with very badly controlled diabetes mellitus **OR** subject ingested 4 g of ammonium chloride with 100 ml of H_2O
Alkalosis	Subject ingested 6.35 g of $NaHCO_3$ with 100 ml of H_2O

Figure 3 Information that students are given regarding samples that have been gathered from volunteers or 'patients'. Students then have to work out which sample came from which individual.

Figure 4. Samples can be made up in bulk and dispensed as and when required.

Figure 5. Samples are randomly coded to make sure that students cannot copy results from one another. All the equipment they need is at their station, but it is up to the students to decide how they undertake the analysis and manage their time.

Figure 6. Students are provided with reference laminates to compare and contrast results from dipstix analysis, but they are expected to know the standard physiological values for urine and arterial blood before they arrive so they can better undertake the analysis and solve the problems set for them.

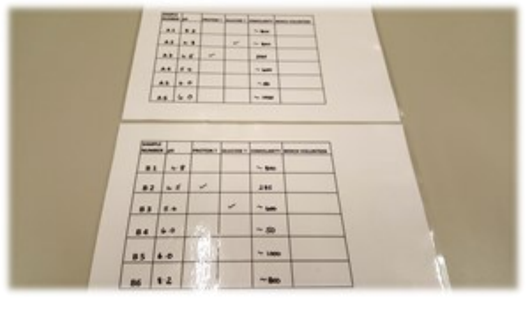

Figure 7. We are about to move to digital/online means of recording results/submitting practical reports. However, we provide laminates for the students to allow them to make notes and problem-solve together, whilst avoiding any handouts or devices being exposed to the samples they are measuring.

Discussion & Conclusions

- This a relatively inexpensive, portable and effective way of engaging students with the practical aspects of the subject.
- Samples are treated as 'real' to improve students' appreciation of various aspects of health and safety.
- Practical can be easily adapted to suit a whole range of class sizes and requirements.
- Has been used to improve health and safety training for students when undertaking exercises where they have to treat these samples as real bodily fluids and when considering concepts such as ethical approval, informed consent and storage of human samples.
- Students get more practice in taking precise measurements, thinking about calibration and what is 'normal'.
- Samples be can developed to mimic a wider range of conditions—urinary tract infection, ingestion of coloured pigments, drug side-effects etc.
- Preparation and clean-up time for teaching technical team reduced greatly whilst still ensuring that students have an enjoyable and worthwhile practical experience.