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| **Title of project** | **Novel use of calcium phosphate cements in drug delivery applications** |
| **Value / what is covered?** | This is an exemplar PhD project within the Malcolm/Boyd group. No funding has yet been secured for the project. We particularly welcome applications from students (particularly international students) who are willing and able to self-fund their PhD. |
| **Awarding body** | N/A |
| **Number of studentships** | 1 |
| **Summary descriptive text / Example of research project** | First discovered in the 1980s, calcium phosphate cements (CPCs) are used today in a range of bone-related applications. The preparation methods and properties of CPCs – including their simple preparation method, the ability to be easily injected in the form of viscous moldable paste , and their ability to harden via a low-temperature non-exothermic setting reaction­ – make them particularly useful in the formulation of controlled release drug delivery systems, with particularly in bone-regeneration applications [1].  In this project, we will assess the potential of CPCs for drug delivery applications outside of bone-related applications. For example, within the Malcolm/Boyd group, we are particularly interested in long-acting delivery of antiretrovirals and contraceptive drugs (both hormonal and non-hormonal drugs) as part of new multipurpose prevention technology (MPT) products targeted as reducing rates of sexually transmitted infections (most notably HIV infection) and unintended pregnancy. To this end, we are particular keen to explore the use of CPCs in long-acting subdermal implants and vaginal ring devices, for which the Malcom/Boyd research group has world-leading knowledge and expertise.  **References**  [1] Ginebra MP, Canal C, Espanol M, Pastorino D, Montufar EB. Calcium phosphate cements as drug delivery materials. Adv Drug Deliv Rev. 2012 Sep;64(12):1090-110. doi: 10.1016/j.addr.2012.01.008. Epub 2012 Jan 25. PMID: 22310160 (<https://www.sciencedirect.com/science/article/pii/S0169409X12000117?via%3Dihub>) |
| **Supervisor(s)** | Professor Karl Malcolm & Dr. Peter Boyd |
| **Eligibility / residence Status** | We will consider UK/EU for DfE studentship, and worldwide applications for self-funded students |
| **Country** | Belfast, Northern Ireland, United Kingdom (UK) |
| **Start date and duration** | September 2022 |
| **Faculty** | Faculty of Medicine, Health & Life Sciences (MHLS) |
| **Research centre / School** | Pharmacy |
| **Subject area** | Drug delivery; pharmaceutics |
| **Candidate requirements / Key skills required for the post** | Applicants should have a 1st or 2.1 honours degree (or equivalent) in a relevant subject. Relevant subjects include Pharmacy, Pharmaceutical Sciences, Biochemistry, Biological/Biomedical Sciences, Chemistry, Engineering, or a closely related discipline. Students who have a 2.2 honours degree and a Master’s degree may also be considered, but the School reserves the right to shortlist for interview only those applicants who have demonstrated high academic attainment to date. |
| **Deadline for applications** | September 2022 |
| **How to apply / contacts** | All postgraduate applications must be made online via the University’s Direct Applications Portal (DAP). The link is provided below.  <https://dap.qub.ac.uk/portal/user/u_login.php>  Please note that applicants do not need to draft a detailed research proposal. Instead, applicants can simply copy and paste the summary descriptive text provided above. However, you may wish to elaborate further on the concept, particularly if you have other ideas around the general topic.  As explained above, this project has not yet secured an external source of funding. Before making an application, students should therefore ensure they have identified a viable funding source to support their postgraduate studies. Self-funding international applicants are particularly encouraged to apply. |
| **Relevant links / more information** | **Funded PhD studentships available in the School of Pharmacy, Queen's University Belfast**  <http://www.qub.ac.uk/schools/SchoolofPharmacy/Research/PostgraduatePositions/>  **Research at the School of Pharmacy, Queen's University Belfast**  <http://www.qub.ac.uk/schools/SchoolofPharmacy/Research/>  **Professor Malcom’s research homepage**  <https://pure.qub.ac.uk/en/persons/karl-malcolm>  **List of recent publications from the Malcolm/Boyd group (with links)**   * Cazorla-Luna R, Ruiz-Caro R, Veiga M-D, Malcolm RK, Lamprou DA, Recent advances in electrospun nanofiber vaginal formulations for women's sexual and reproductive health, Int J Pharm. 2021:121040. Click [here](https://www.sciencedirect.com/science/article/pii/S0378517321008462) to download article. * Dallal Bashi YH,Murphy DJ, McCoy CF, Spence P,  Boyd P, Brown L, Kihara, M, Martin F, McMullen N, Kleinbeck K, Dangi B, Spence P, Hansraj B, Devlin B, Malcolm RK, Silicone elastomer formulations for improved performance of a multipurpose vaginal ring releasing dapivirine and levonorgestrel. Int J Pharm X. 2021;100091. Click [here](https://www.dropbox.com/s/a0ix8ycgxsr88r0/DallalBashi2021.pdf?dl=0) to download article. * Carson L, Merkatz R, Martinelli E, Boyd P, Variano B, Sallent T, Malcolm RK, The vaginal microbiota, bacterial biofilms and polymeric drug-releasing vaginal rings. Pharmaceutics. 2021;13(5)751. Click [here](https://www.mdpi.com/1999-4923/13/5/751) to download article. * McCoy CF, Spence P, Dallal Bashi YH, Murphy D,J Boyd P,  Dangi B, Derrick T, Devlin B, Kleinbeck K, Malcolm RK, Use of simulated vaginal and menstrual fluids to model in vivo discolouration of silicone elastomer vaginal rings. Int J Pharm X. 2021;100081. Click [here](https://www.sciencedirect.com/science/article/pii/S2590156721000104) to download article. * Boyd P, Merkatz R, Variano B, Malcolm RK, The ins and outs of drug-releasing vaginal rings: A literature review of expulsions and removals. Expert Opinion on Drug Delivery. 2020;17:1519-1540. Click [here](https://www.dropbox.com/s/a69mv5vohxt8i4y/Boyd2020.pdf?dl=0) to download article. * Welsh NR, Malcolm RK, Devlin B, Boyd P, Dapivirine-releasing vaginal rings produced by plastic freeforming additive manufacturing. Int J Pharm. 2019;572:118725. 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Click [here](https://www.dropbox.com/s/769ngtr5krvrgsd/Bashi2019.pdf?dl=0) to download article. * Murphy DJ, McCoy CF, Boyd P, Derrick T, Spence P, Devlin B, Malcolm RK, Drug stability and product performance characteristics of a dapivirine- releasing vaginal ring under simulated real-world conditions, International Journal of Pharmaceutics 2019;565:351–357. Click [here](https://www.dropbox.com/s/go7vldzd9maso0h/Murphy2019.pdf?dl=0) to download article. * Murphy DJ, Post-use ring weight and residual drug content as potential objective measures of user adherence to a contraceptive progesterone vaginal ring, Contraception 2019;100(3):241-246. Click [here](https://www.dropbox.com/s/y8xx90oznjf9pld/Murphy2019c.pdf?dl=0) to download article. * McBride JW, Malcolm RK, Dias N, Cameron D, Offord RE, Hartley O, Kett VL, Devlin B, Boyd P, Development and pharmacokinetics of a combination vaginal ring for sustained release of dapivirine and the protein microbicide 5P12-RANTES. 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Click [here](https://www.dropbox.com/s/k2l7d0bgcifa8wz/Malcolm2016.pdf?dl=0) to download article. * Murphy DJ, Boyd P, McCoy CF, Kumar S, Holt JD, Blanda W, Brimer AN, Malcolm RK, Controlling levonorgestrel binding and release in a multi-purpose prevention technology vaginal ring device. J. Controlled Release, 2016;226:138-47. Click [here](https://www.dropbox.com/s/jq5z1dy8uc8k65s/Murphy2016b.pdf?dl=0) to download article. * Murphy DJ, Amssoms K, Pille G, Clarke A, O'Hara M, van Roey J, Malcolm RK. Sustained release of the candidate antiretroviral peptides T-1249 and JNJ54310516-AFP from a rod insert vaginal ring. Drug Deliv Transl Res. 2016;6(3):234-42. Click [here](https://www.dropbox.com/s/vkgiv47lz82xded/Murphy2016.pdf?dl=0) to download article. * Boyd P, Fetherston SM, McCoy CF, Major I, Murphy DJ, Kumar S, Holt J, Brimer A, Blanda W, Devlin B, Malcolm RK, Matrix and reservoir-type multipurpose vaginal rings for controlled release of dapivirine and levonorgestrel, Int J Pharm. 2016;511(1):619–629. Click [here](http://authors.elsevier.com/a/1TSej1M49kBWX5) to download article. |
| **Keywords for search filters** | Calcium phosphate cements; drug delivery; sustained release; controlled release; sub-dermal implants; vaginal rings; hormonal and non-hormonal contraception; HIV prevention; multi-purpose prevention technologies; sexually transmitted infections |
| **Training provided through the research project** | The project will provide extensive training and skills development for the student in the following topics:   * drug formulation methods * preparation and characterisation of drug delivery devices * drug quantification using high performance liquid chromatography (HPLC) and other analytical methods * in vitro drug release testing * use of thermal analysis methods * rheological and mechanical testing methods * planning and organising skills: designing and planning of experiments * numeracy and statistical skills * teamwork skills: working confidently as part of a large research team * the student will receive additional support from senior postdoctoral researchers working in the Malcolm/Boyd group |
| **Expected impact activities** | To the best of our knowledge, this project will investigate for the first time the potential use of CPCs for drug delivery uses outside bone-related applications. We anticipate the student will successfully complete their PhD within three years of starting the project, and will be sufficiently skilled and trained to further develop their career, particularly in an academic or pharmaceutical industry setting. As part of the PhD project, students will be encouraged to draft and submit original research manuscripts and review articles for publication in leading international scientific journals. |