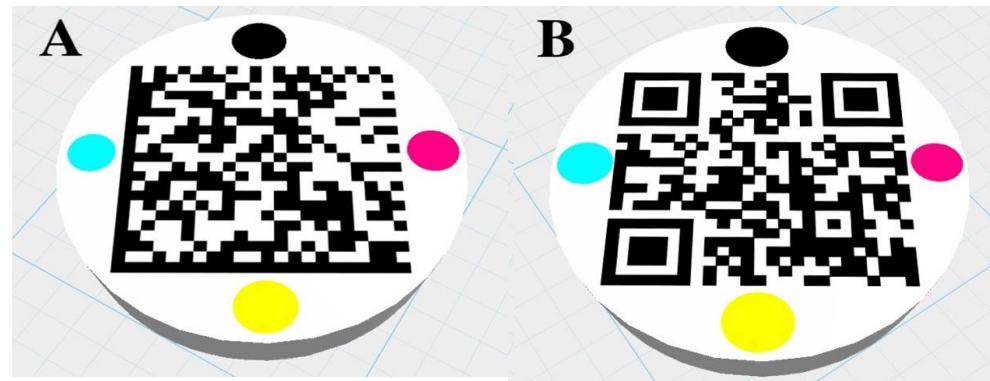


Track-and-Trace: Novel Anti-Counterfeit Measures using 3D Printing

Sarah Trenfield, MPharm
PhD Researcher at University College London (UCL)
12th Sep 2019 - APS PharmSci 2019 Conference



sarah.trenfield.16@ucl.ac.uk

@SarahTrenfield1

@BasitResearch

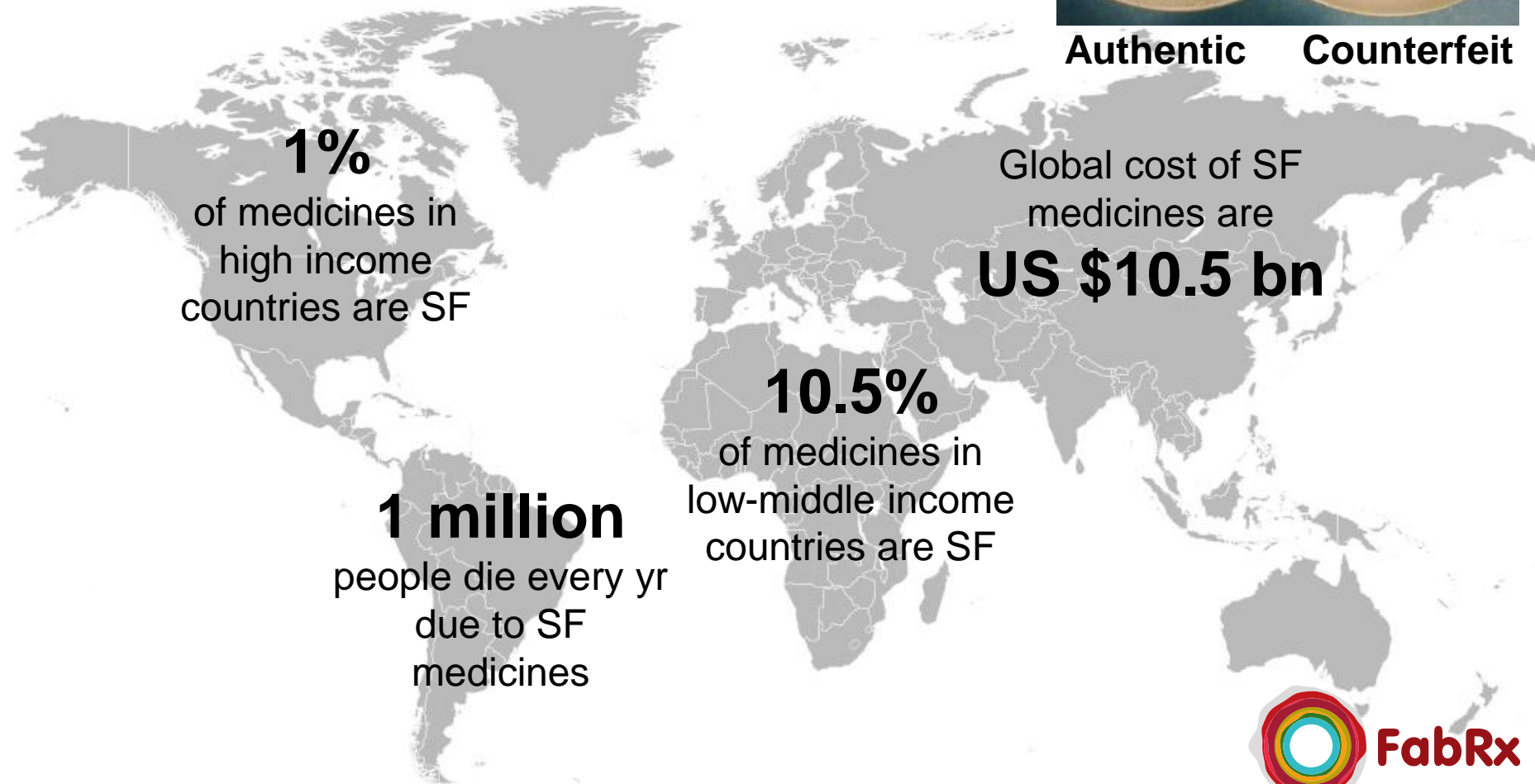


SF medicines: A global crisis



Authentic

Counterfeit



Current Strategies: Packaging

Tamper Evident



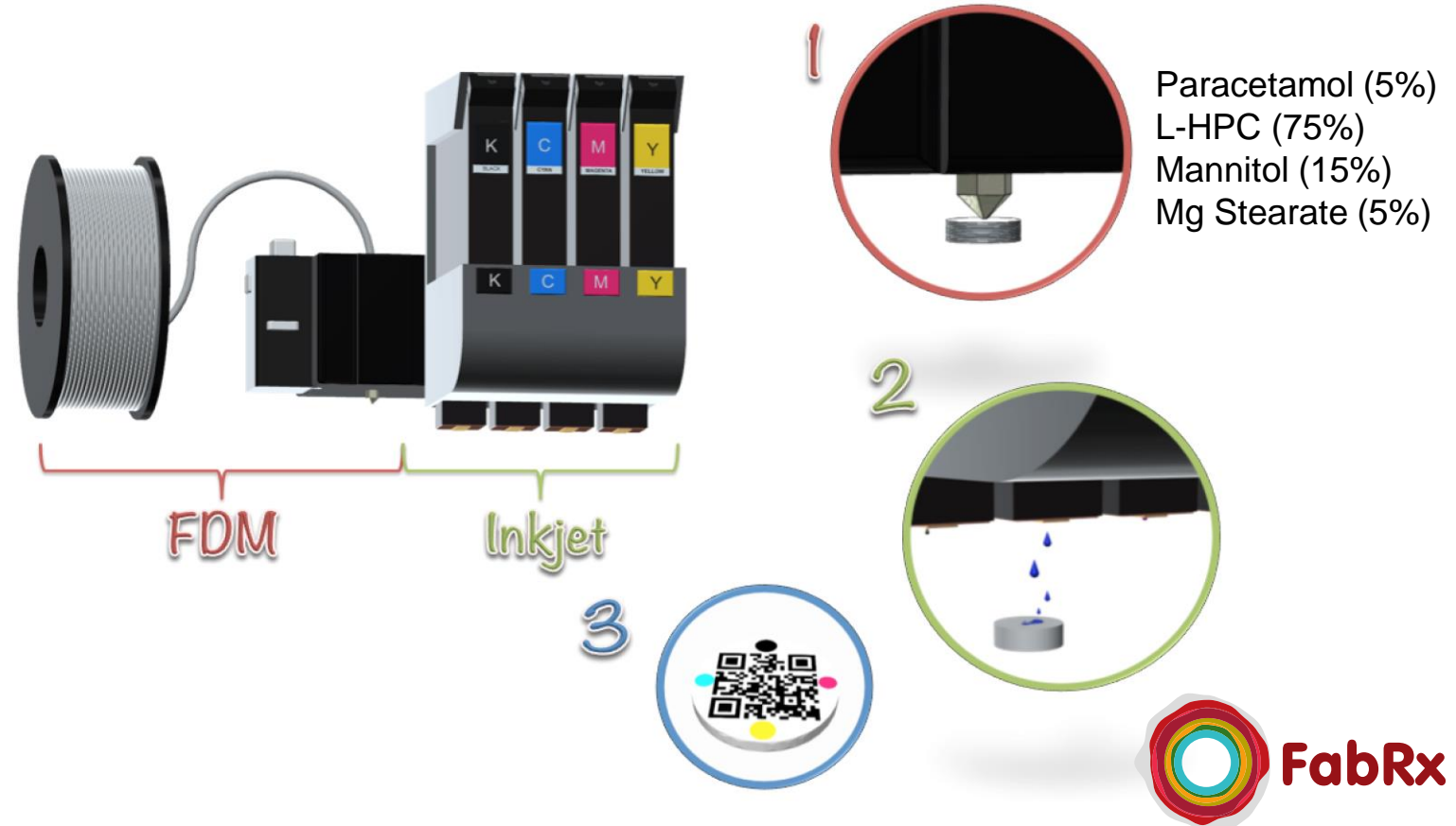
Serialisation



- Unsuitable for personalised, 'one-off' batches of medicines
- Better strategy could be to directly label the dosage form
 - Individual drug product QC
 - Real-time medication adherence

Project Aim

Use a novel 2D-3D printing process to develop personalised drug products with a fail-safe anti-counterfeit mechanism



Step 1. Drug Product Design



Track-and-Trace

- Design QR codes & data matrices to contain information relating to:
 - Patient
 - Manufacturer
 - Drug dosage, form, batch number, expiry
 - Prescriber & pharmacist

Designed by:

<https://www.datamatrix.kaywa.com>

<https://www.qr-code-generator.com/>



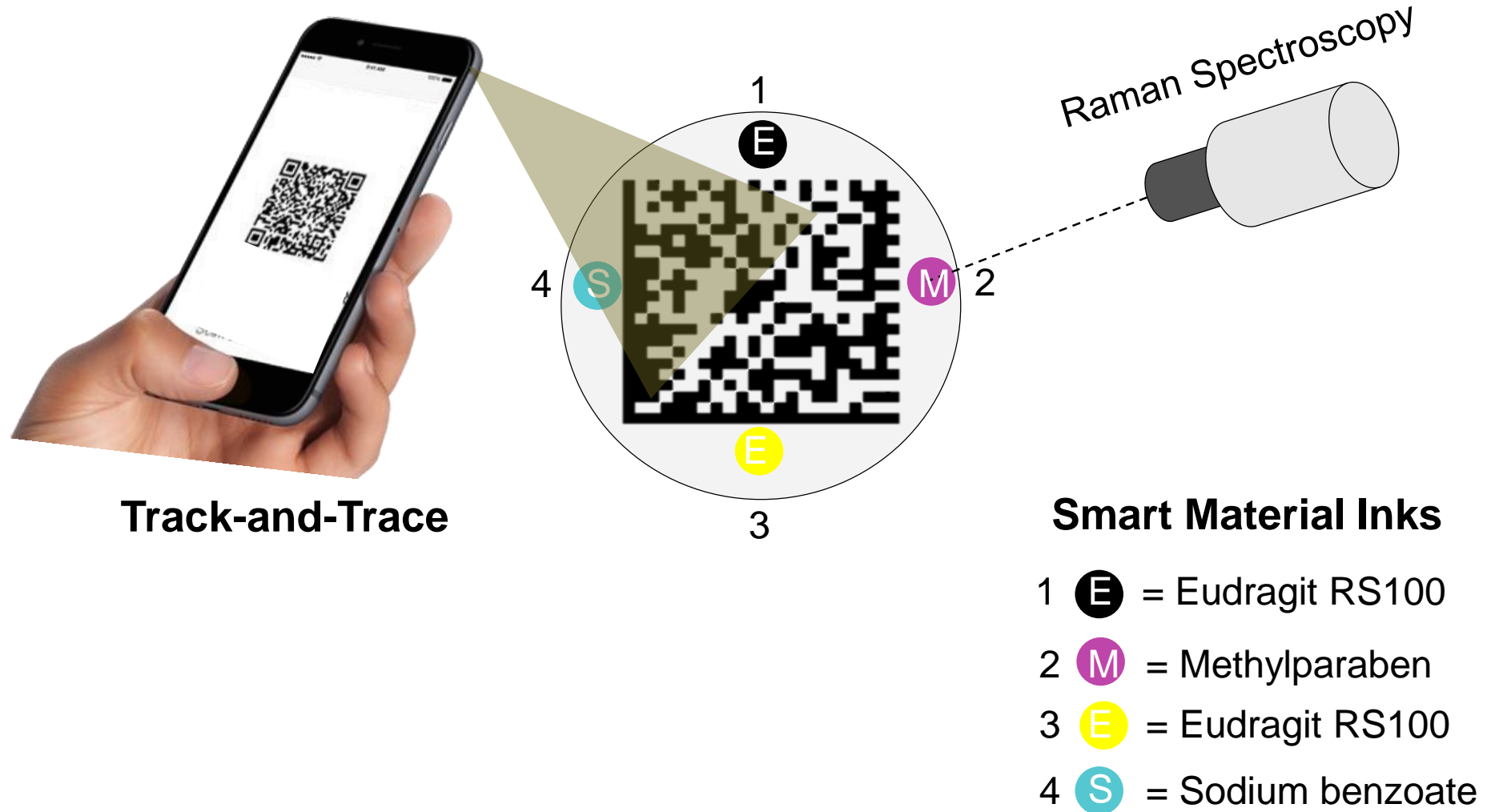
Step 1. Drug Product Design



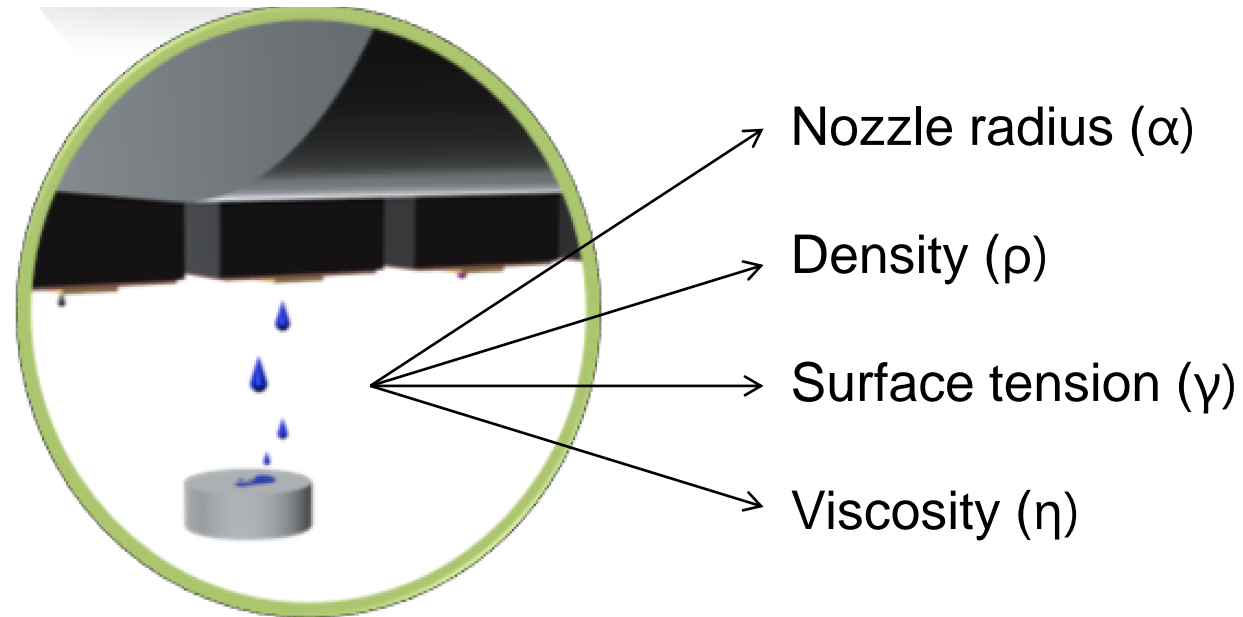
Track-and-Trace

<u>Track-and-trace of 3D printed medicines</u>	
Treatment information	Patient information
Active ingredient/Dose Drug X 100mg	Name Ms K. Finch
Batch N-102276	Date of birth 22/08/1974
Manufactured by Manufacturing Company	Gender Female
Expiry date 15/07/2021	Legal Category Prescription Only Medicine (POM)
Prescribed by and Date Dr A. Smith, 04/01/2019	Anti-counterfeit code 1E,2M,3E,4S
Approved by and Date Ms S. Jones, 04/01/2019	

Step 1. Drug Product Design



Step 2: Development of Smart Inks

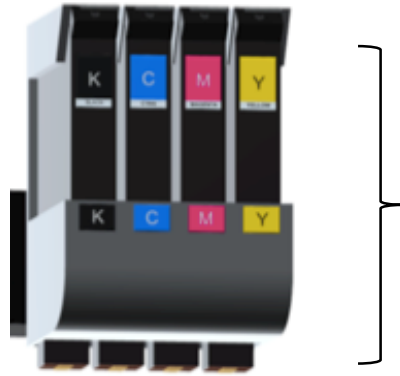


$$\text{Ink Printability (Z Value)} = \frac{(\alpha\rho\gamma)^{1/2}}{\eta}$$

Target = 1-10

Step 2: Development of Smart Inks

Original Inks

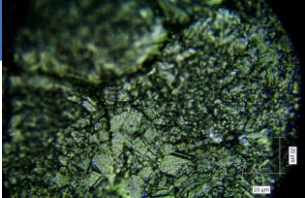
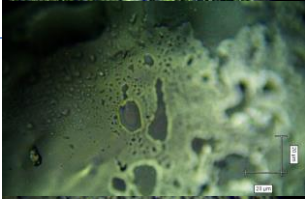
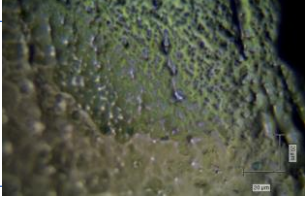


Surface tension: 25 – 28 mNm⁻¹

Viscosity: 0.9 – 1 mPa.s


Z value = >1

Smart Inks


Ink Composition	Surface Tension (mNm ⁻¹)	Dynamic Viscosity (mPa.s)	Z value	Visual confirmation?
Methylparaben 20% w/v	28.3 ± 0.7	1.0 ± 0.05	3.58	
Eudragit RS100 10% w/v	27.9 ± 0.6	3.31 ± 0.4	1.15	
Sodium benzoate 2% w/v	27.4 ± 0.8	0.91 ± 0.07	4.58	

Step 3: Printing & Smartphone Scanning


Data Matrix




QR Code




✓ ✓ ✓



12 x 12mm 15 x 15mm 20 x 20mm

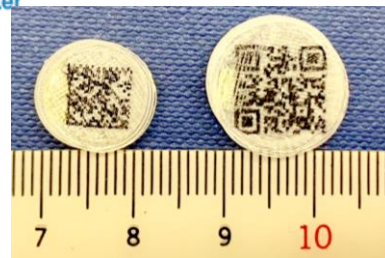
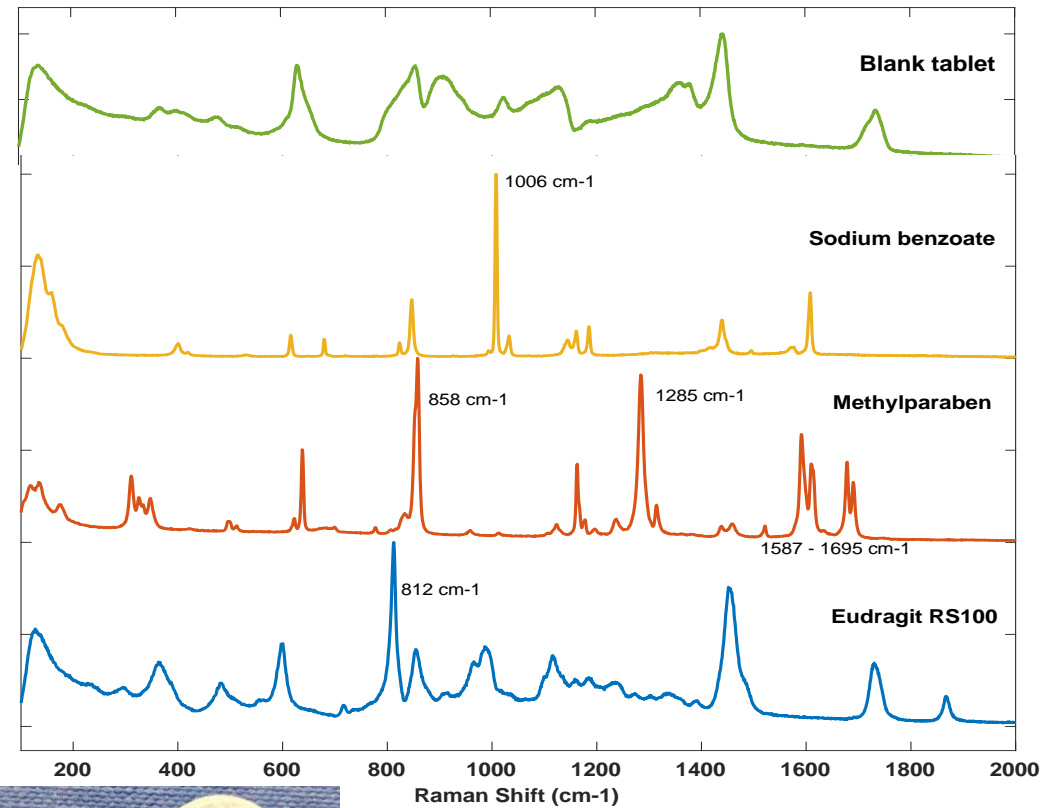
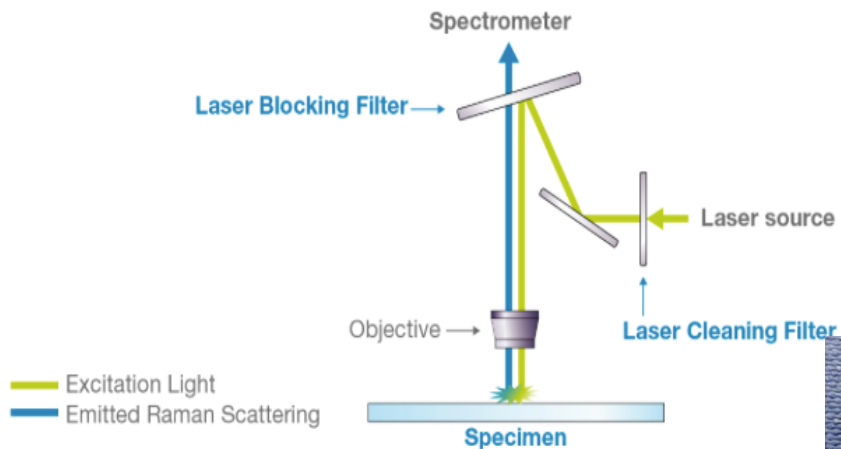


X ✓ ✓

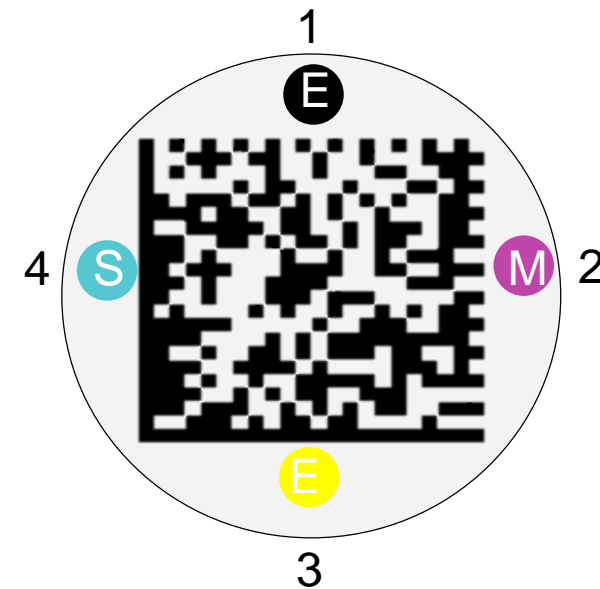
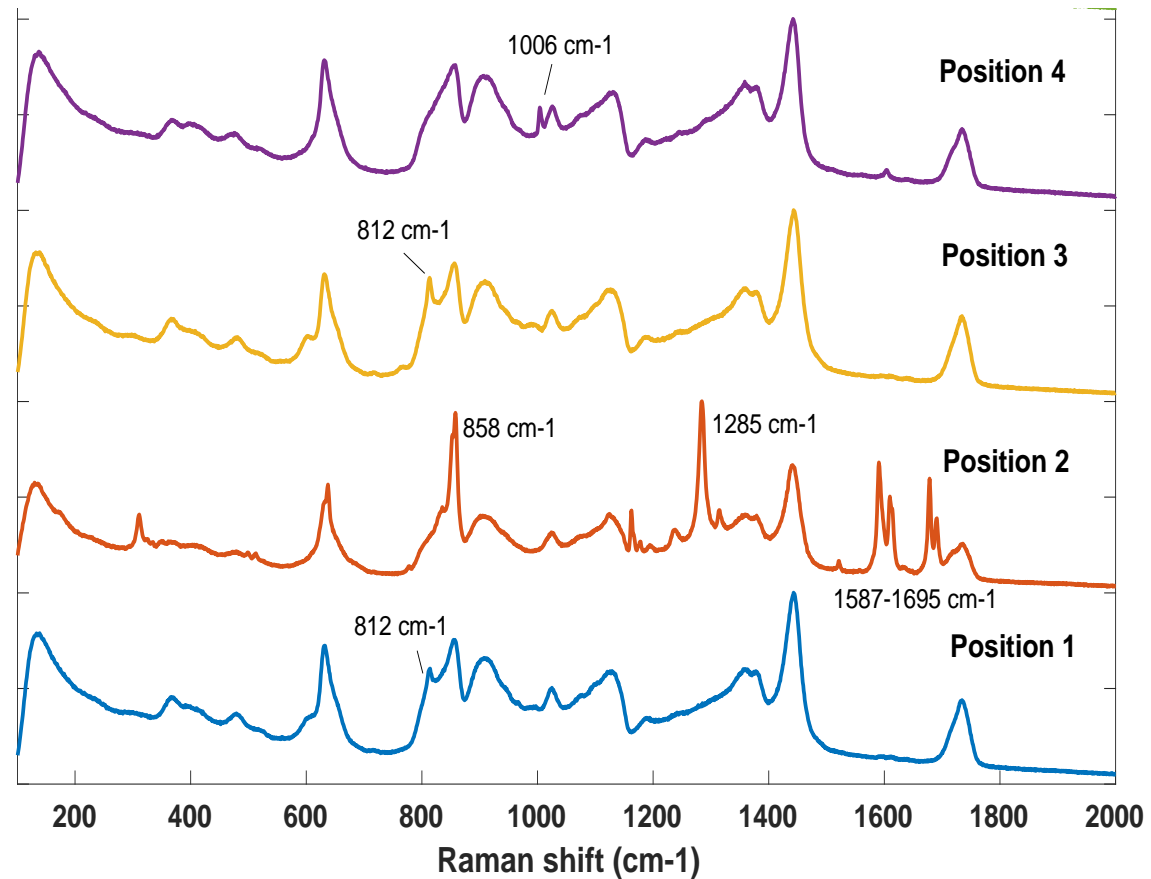


Step 4: Raman Detection of Smart Inks

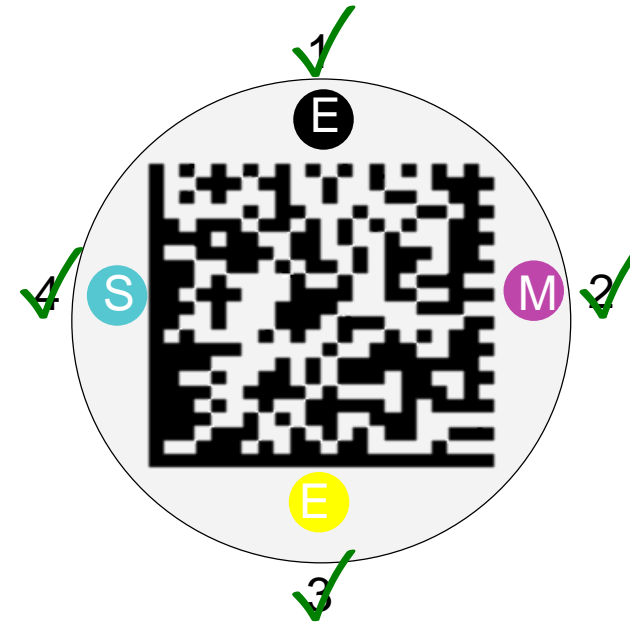
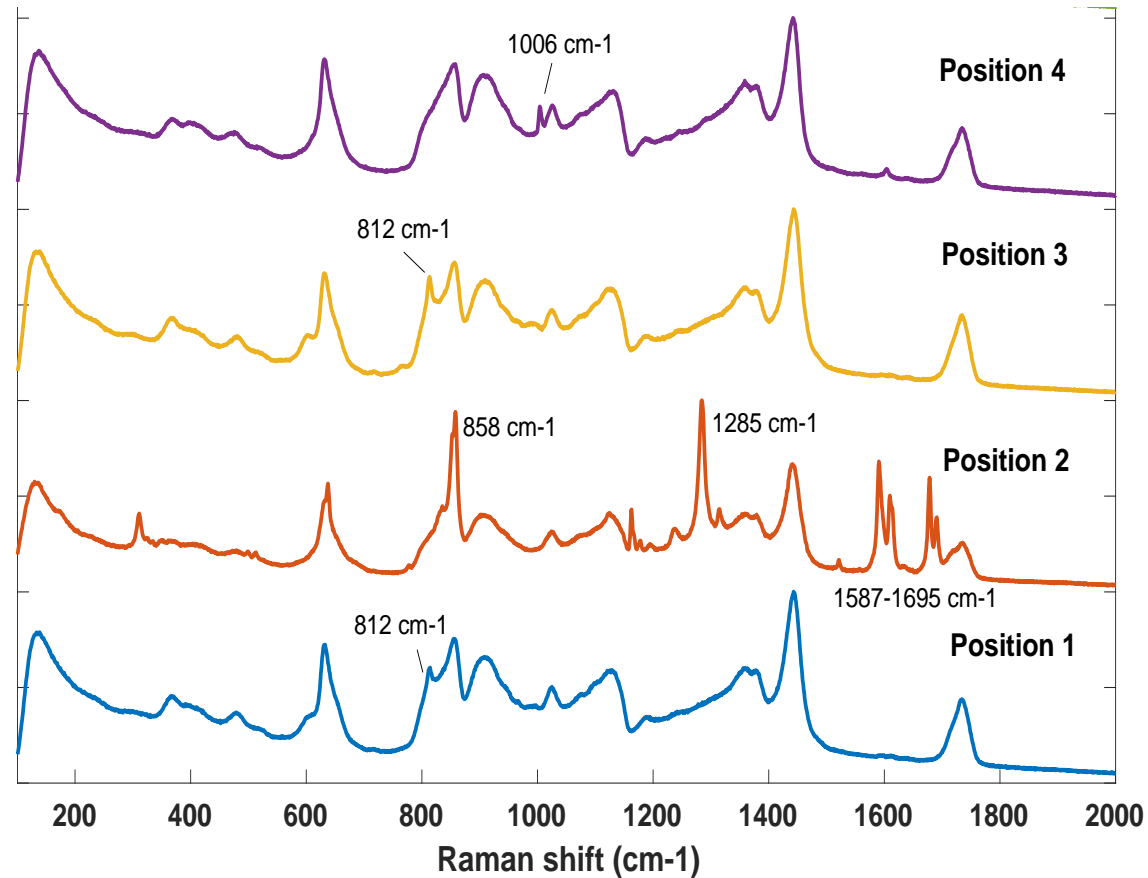
- Renishaw InVia Raman microscope, 785nm NIR laser, x50 lens
- ✓ Non-destructive, no sample preparation, rapid, spatial distribution



Step 4: Raman Detection of Smart Inks

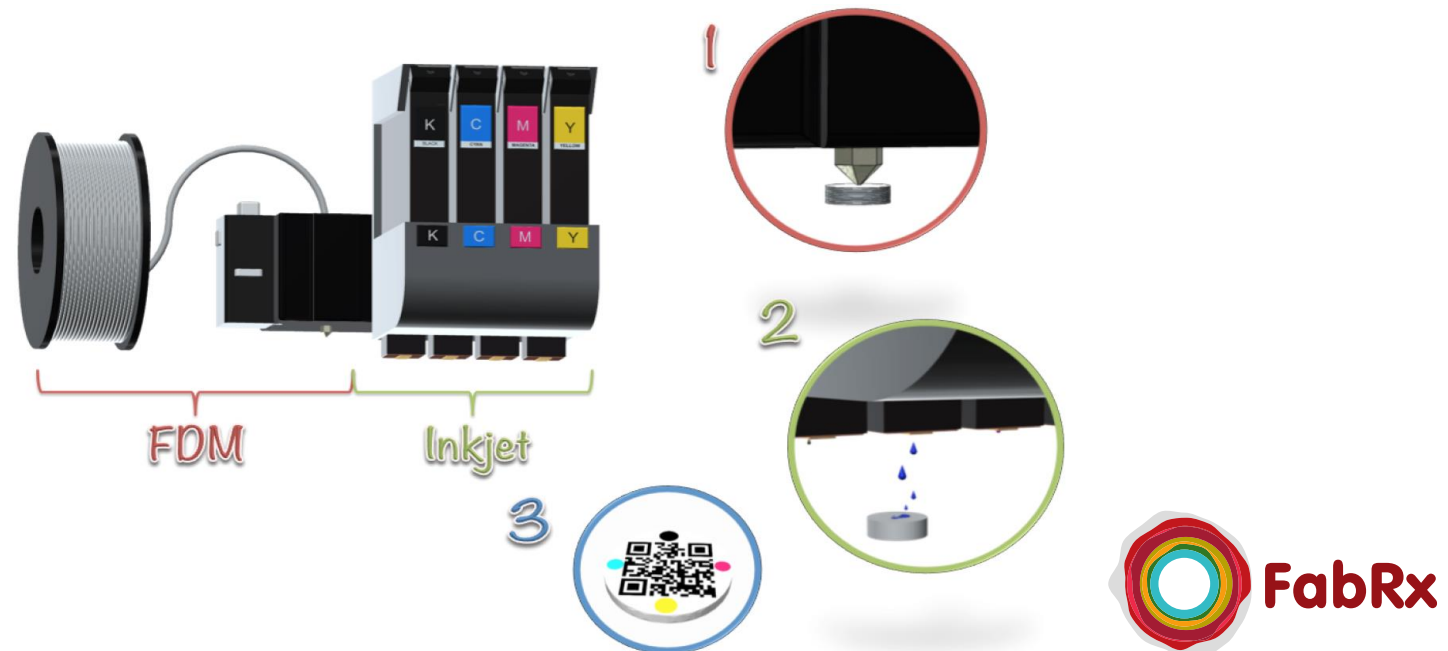


Step 4: Raman Detection of Smart Inks



Conclusions

- Used a novel 2D-3D printing technology to produce personalised drug products with dual:
 - Track-and-trace (QR codes / data matrices)
 - & Anti-counterfeit method (Raman-active material inks)



Acknowledgements



- Prof. Abdul Basit
- Prof. Simon Gaisford
- The wonderful Basit Research Group!
- You all! 😊



EPSRC
Pioneering research
and skills
(EP/L01646X)

CDT in Advanced Therapeutics
and Nanomedicines



Any Questions?

