# Tools for change: Quantifying and Understanding Diagnostic Plastic Waste


*Alice Street*

*Maïwenn Kersaudy-Kerhoas*



ASLM Waste Sub-CoP session
24th March 2026



Photograph: Edward Krisiunas / ASLM

THE UNIVERSITY of EDINBURGH

HERIOT WATT UNIVERSITY

# Outline

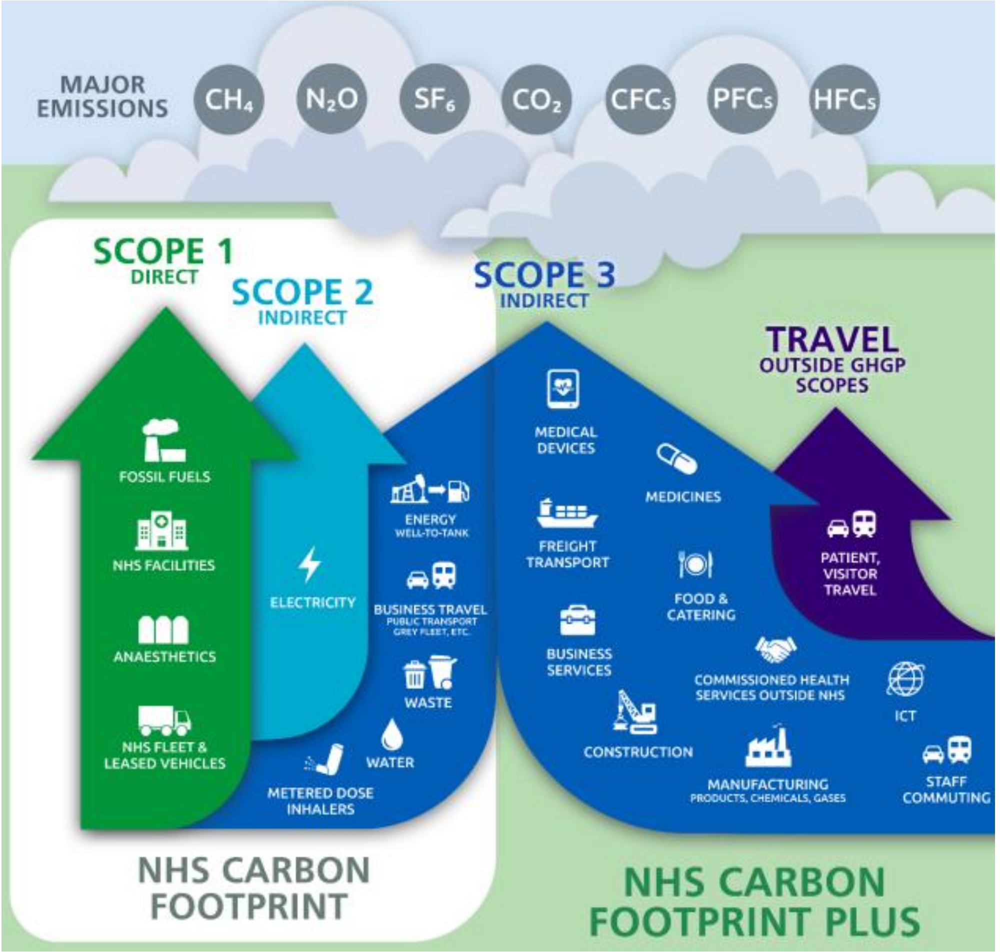
- POCT Waste: Scale of the problem
- Material usage in POCTs
- Measuring single-use laboratory waste
  - *Survey*
- Introducing Sustainable materials in POCTs
- Conclusions

ASLM
AFRICAN SOCIETY FOR LABORATORY MEDICINE

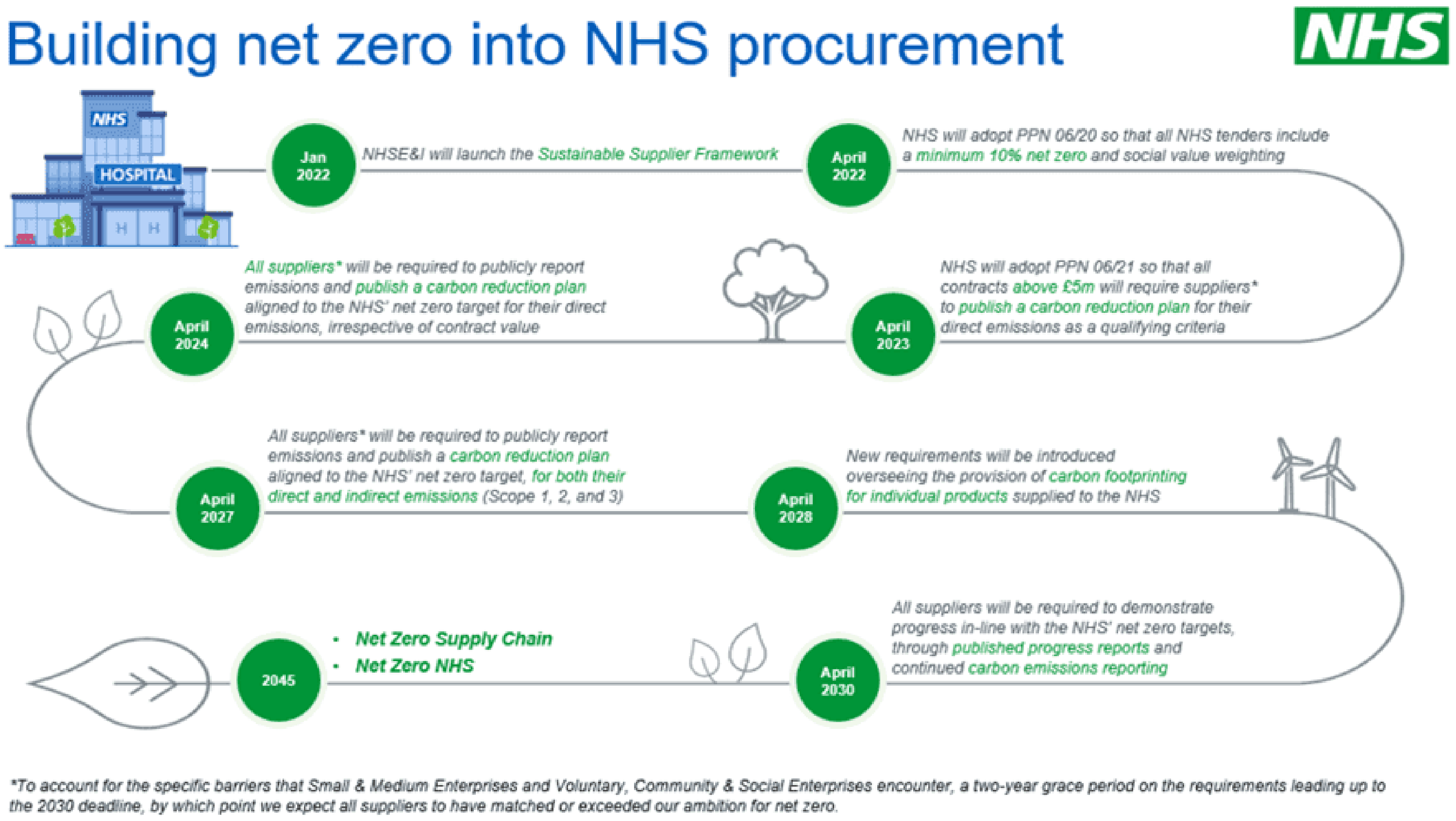

Photograph: Edward Krisiunas / ASLM

# Why are we interested in medical waste?

- The healthcare sector is responsible for ~4% of global carbon emissions
- Approximately 6–10% of national health system emissions come from medical devices
- In the UK, strong emphasis on decarbonization
- Most carbon emissions embedded in “scope 3” emissions



# Why are we interested in medical waste?




- From 1 April 2022, all NHS procurements will include a minimum 10% net zero and social value weighting.
- From April 2028, new requirements will be introduced **overseeing the provision of carbon foot printing for individual products** supplied to the NHS. The NHS will work with suppliers and regulators to determine the scope and methodology.

# Research: Diagnostic waste flows Sierra Leone

Qualitative research: Mapping the life-cycle of diagnostic devices

Surveys: Waste management infrastructure at point of testing

THE UNIVERSITY of EDINBURGH

DiaDev
Investigating Diagnostics in Global Health

# Key findings

- LFAs used at every level of health system, laboratories and clinics
- 47% of Community Health Centres had functioning incinerators
- Segregated health care waste was re-mixed at point of discard
- Mixed health care waste was openly burned, buried, or sent to landfill.


Street, A., Vernooij, E., & Rogers, M. H. (2022). Diagnostic waste: whose responsibility?. *Globalization and Health*, *18*(1), 30.

Street, A., Vernooij, E., Koker, F., Baxter, M. S., Bah, F., Rogers, J., ... & Ansumana, R. (2023). The "ready-to-hand" test: Diagnostic availability and usability in primary health care settings in Sierra Leone. *PLOS global public health*, *3*(2), e0000604.

THE UNIVERSITY of EDINBURGH

DiaDev
Investigating Diagnostics in Global Health

# Key Lessons

- Global health system prioritises single-use devices and deprioritizes waste infrastructure
- Costs of diagnostic waste are ‘externalized’ to users
- Focus on ‘speed’ and ‘access’ removes incentives for manufacturers, regulators, policy makers to consider impact of waste.

Street *et al. Globalization and Health* (2022) 18:30
https://doi.org/10.1186/s12992-022-00823-7

Globalization and Health

COMMENTARY Open Access

## Diagnostic waste: whose responsibility?

Alice Street[1*], Eva Vernooij[1] and Mohamed Hashim Rogers[2]

**Abstract**

Waste management is notably absent from current discussions about efforts to improve access to diagnostics in low- and middle-income Countries (LMICs). Yet an increase in testing will inevitably lead to an increase in diagnostic waste, especially since many of the diagnostic tests designed for use in LMICs are single-use point-of-care tests. Diagnostic waste poses a threat to both human and environmental health. In this commentary we draw on our experience of diagnostic waste management in Sierra Leone and review current evidence on: the volume and impact of diagnostic waste in LMICs, existing health-care waste management capacity in LMICs, established national and international policies for improving health-care waste management, and opportunities for strengthening policy in this area. We argue that questions of safe disposal for diagnostics should not be an afterthought, only posed once questions of access have already been addressed. Moreover, responsibility for safe disposal of diagnostic waste should not fall solely on national health systems by default. Instead, consideration of the end-life of diagnostic products must be fully integrated into the diagnostic access agenda and greater pressure should be placed on manufacturers to take responsibility for the full life-cycle of their products.

**Keywords:** Diagnostics, Waste management, Sustainability, Responsibility, Product development

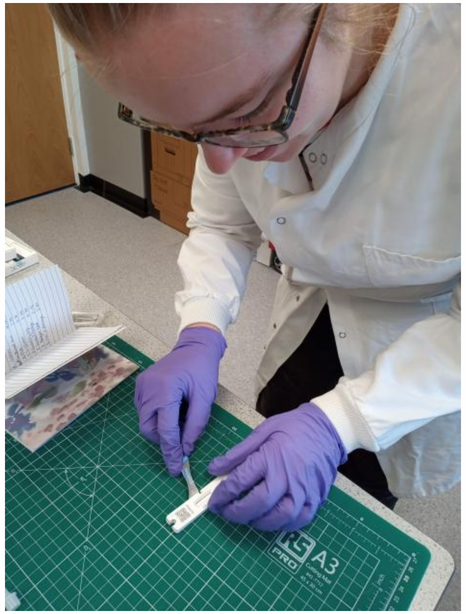
### Background

‘Discard sample and assay waste according to your local safety regulations.’ So states the standard small print found at the bottom of countless manufacturer labels for single-use diagnostic products. But what if no local or national guidelines or regulations exist? Or what if those guidelines exist on paper, but there is no infrastructure, systems, or workforce in place to enable health facilities to adhere to them? Since the start of the COVID-19 pandemic, the diagnostics pillar of the Access to COVID-19 Tools (ACT) Accelerator partnership has procured over 116.9 million tests for use in low-and-middle-income countries (LMIC), of which 43.2 million were polymerase chain reaction (PCR) tests and 73.7 million antigen-detecting rapid diagnostic tests (Ag-RDT) [20]. This achievement represents valuable progress in efforts to improve global access to life-saving diagnostic tools in the pandemic. But with the global health community’s attention focused on questions of diagnostic access, far less consideration has been given to the end-life of diagnostic products [13, 15].

Cartridge-based polymerase chain reaction (PCR) tests and Ag-RDT tests [lateral flows] used to detect the SARS-CoV-2 virus are single-use devices. Their self-contained, easy-to-use format makes them especially promising for the extension of testing to places with limited laboratory infrastructure, and for the decentralisation of community testing. Yet, each one of those 116.9 million tests has also generated plastic, infectious, and potentially toxic waste that must be disposed of safely after use. Diagnostic waste poses multiple threats to human and environmental health [21, 24]. Ag-RDT cassettes are made from petroleum-derived plastics, which have a large $CO_2$ footprint and are non-biodegradable. A recent study estimated that PCR testing for COVID-19 generated 15,000 tons of plastic waste globally to August 2020 [5]. A World Health Organization (WHO) report on COVID-19 related healthcare waste calculated that test kits procured solely through the

*Correspondence: alice.street@ed.ac.uk
[1] School of Social and Political Science, University of Edinburgh, Edinburgh, UK
Full list of author information is available at the end of the article

# Research: Material components of LFAs

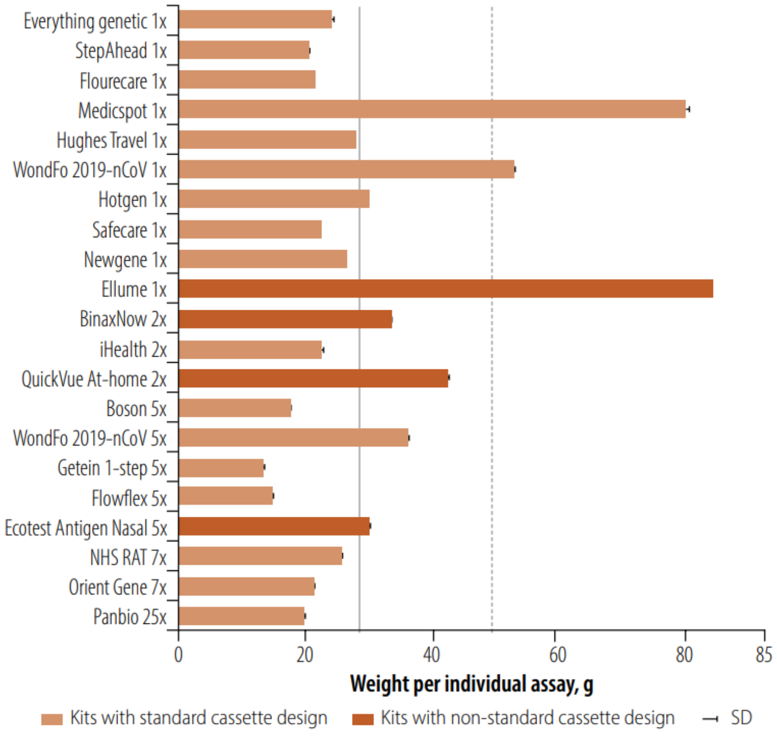



- 22 Covid-19 LFAs
- Manually deconstruct
- Weigh components

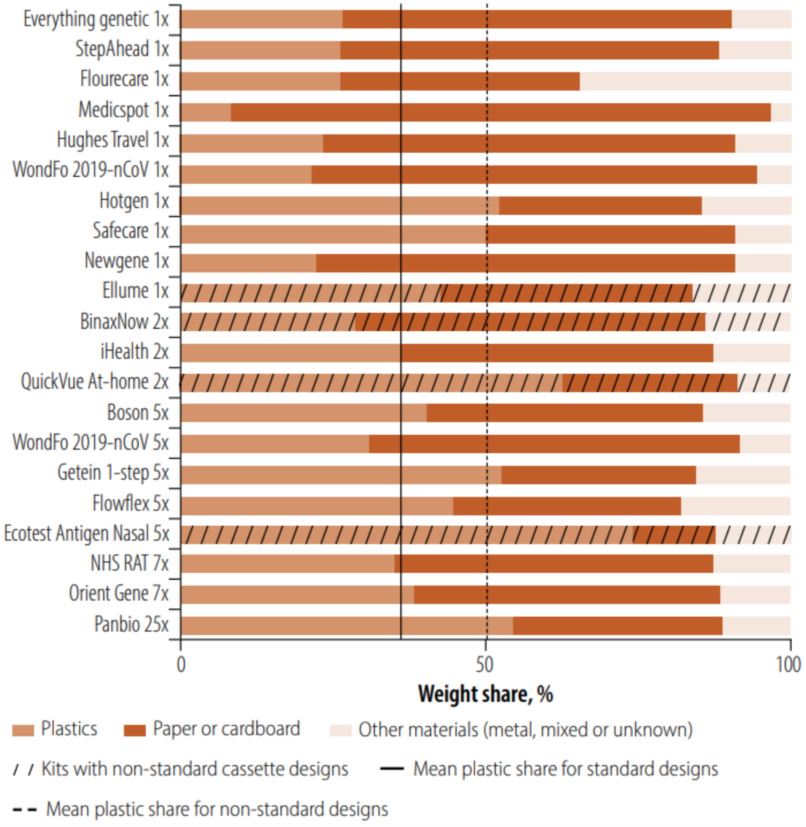
Wöhrle, M.-L., Street, A., & Kersaudy-Kerhoas, M. (2025). Mass of components and material distribution in lateral flow assay kits, *WHO Bulletin 103 : 236–246.* http://dx.doi.org/ 10.2471/BLT.24.292167

# Key findings

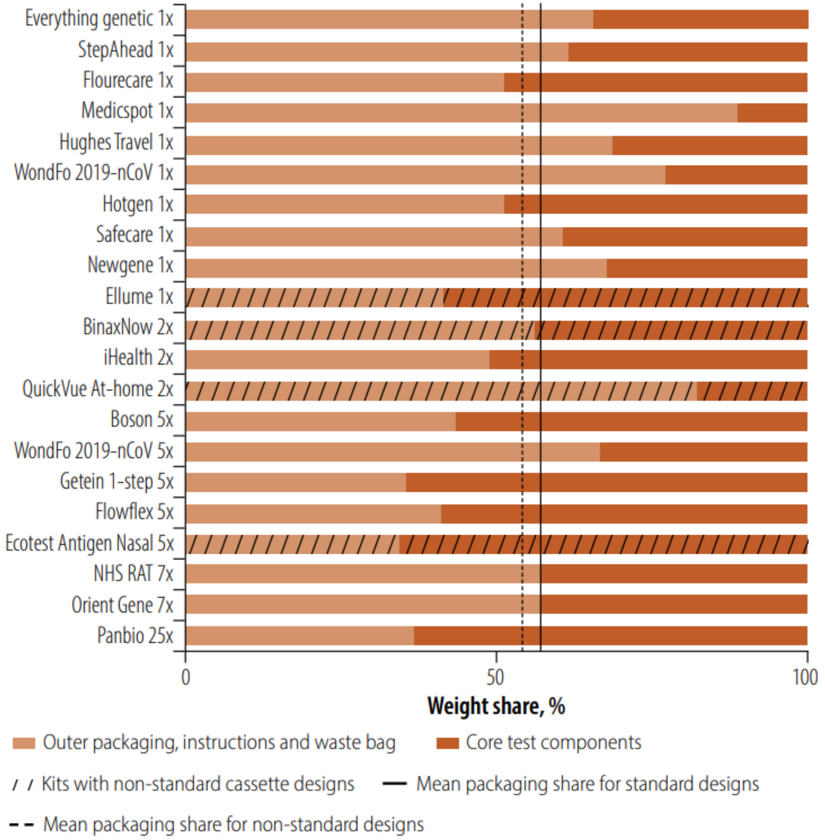
Wöhrle, M.-L., Street, A., & Kersaudy-Kerhoas, M. (2025). Mass of components and material distribution in lateral flow assay kits, *WHO Bulletin 103 : 236–246.*
http://dx.doi.org/ 10.2471/BLT.24.292167



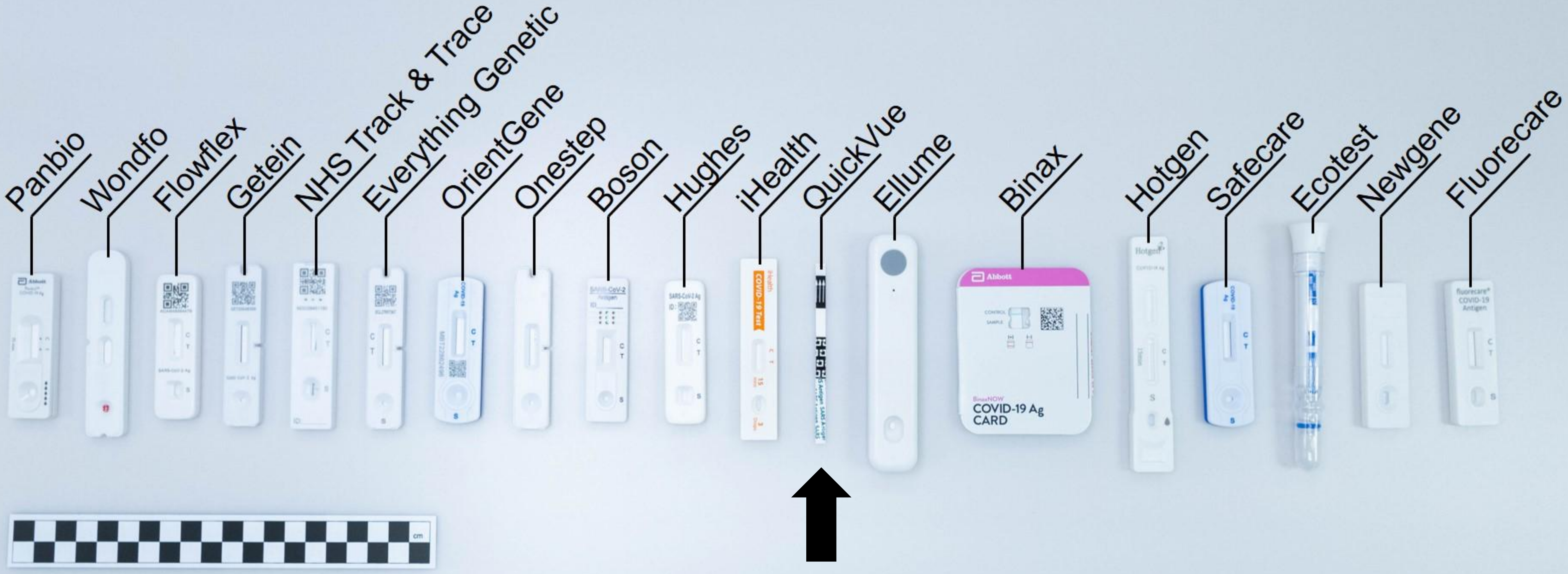

**Large weight variations between kits**




**Large variations in plastic 'weight share'**



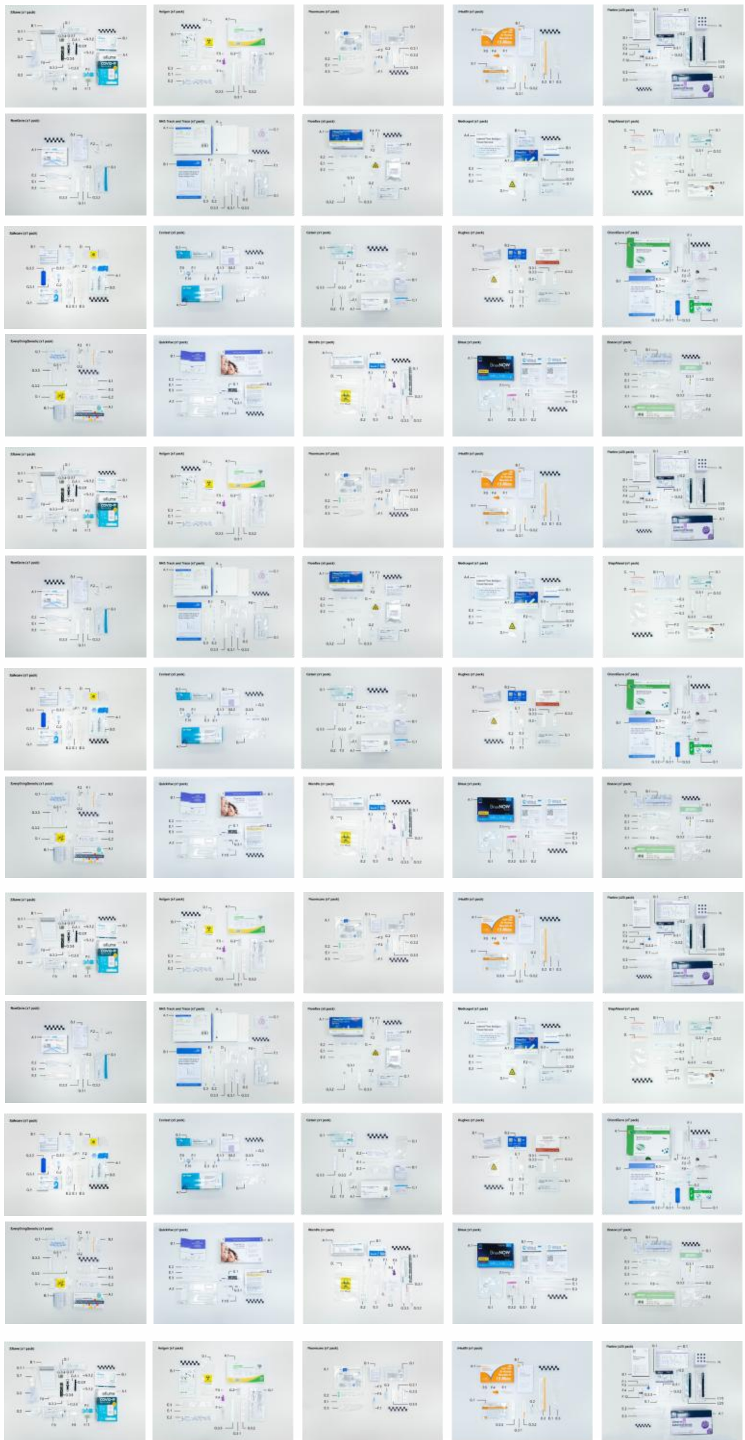

**Packaging made up on average 57% of the whole test kit weight**




Wöhrle, M.-L., Street, A., & Kersaudy-Kerhoas, M. (2025). Mass of components and material distribution in lateral flow assay kits*, WHO Bulletin 103 : 236–246.* http://dx.doi.org/ 10.2471/BLT.24.292167

# Key lessons

- Lower waste options are available on market
- Easy wins available in packaging
- Case for including environmental criteria in TPPs
- Shift responsibility from the user to the regulator and manufacturer
- Role for procurement



HERIOT WATT UNIVERSITY

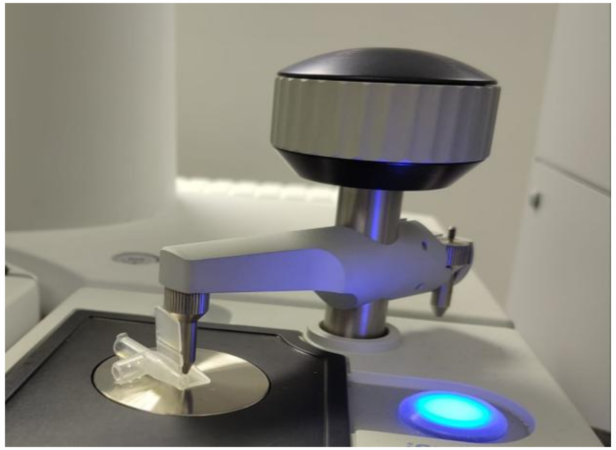
**After the Single Use**
Rethinking Plastics in Healthcare

THE UNIVERSITY of EDINBURGH

# Research: Materials analysis

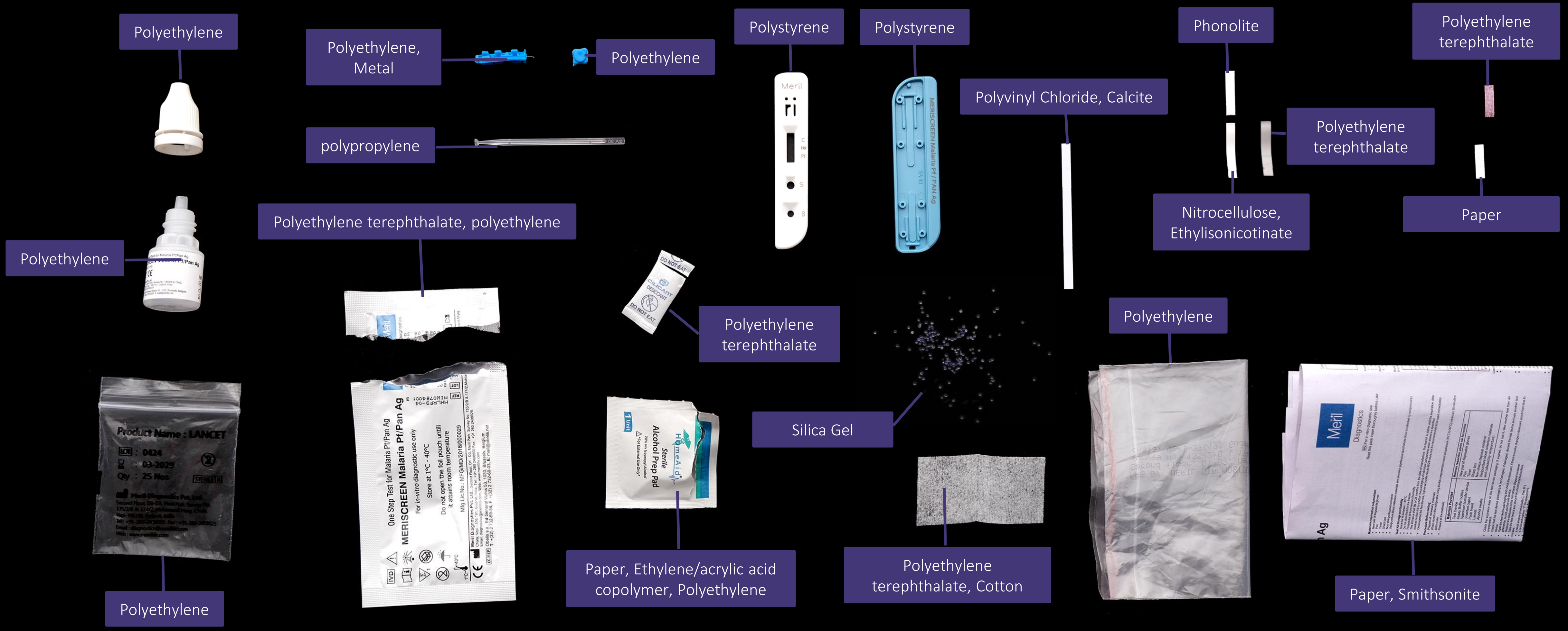
Materials data not publicly available

Deconstruct devices into individual material components



Use **Fourier-Transform Infrared spectroscopy (FTIR)** to identify materials

# Key findings

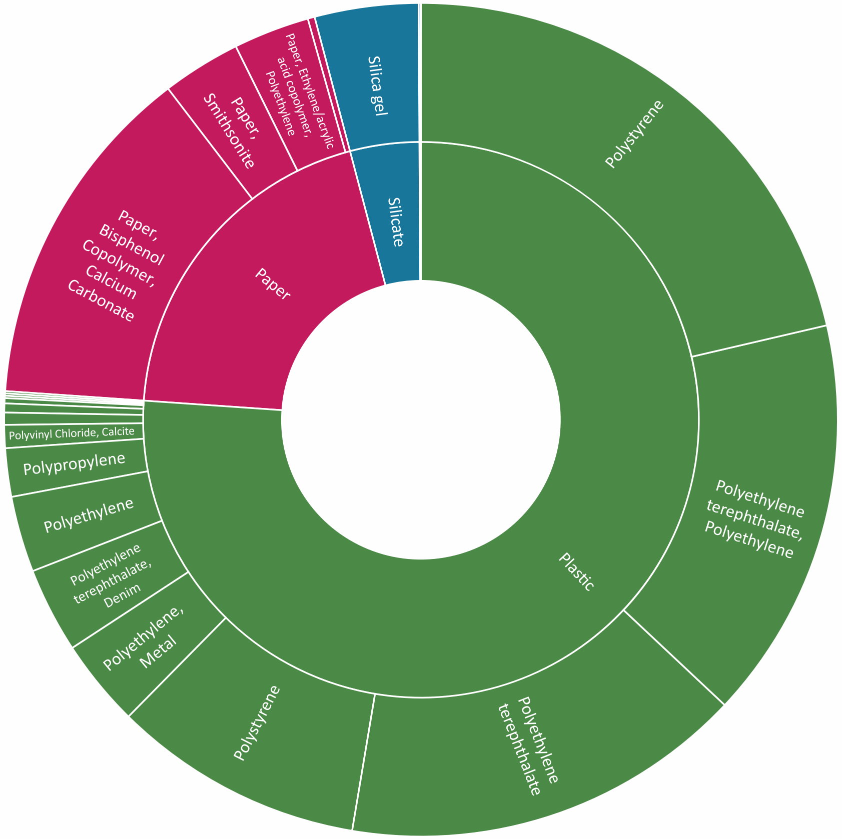



HERIOT WATT UNIVERSITY

After the Single Use
Rethinking Plastics in Healthcare

THE UNIVERSITY of EDINBURGH

# Key findings




- 20 components and 6 different plastics
- Presence of harmful materials and additives (PVC, Bisphenols, Polystyrene)
- Complex harmful packaging

*Research carried out with Millie Marriott Webb and Alexandra Grosse*

# Key lessons

- Materials data is not publicly available
- Harmful materials – an issue beyond wet chemistry (e.g. GTC) and not confined to point of disposal.
- Rationale for materials not always self-evident
- Data can be fed into Life Cycle Analysis
- Need to expand analysis from ‘device’ to ‘procedure’

HERIOT WATT UNIVERSITY · THE UNIVERSITY of EDINBURGH · Abertay University · University of Dundee

# Measuring Laboratory waste

## A meta-analysis by Slutzman et al, 2023

2398 studies screened

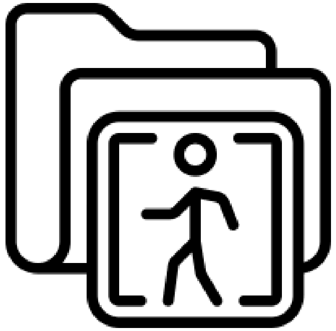
↓

156 studies included

- Studies predominantly done in high-income countries (50%), followed by lower-middle-income (26%), upper-middle-income (20%), and low-income (5%) (Slutzman, 2023)
- Objectives for conducting the audit (all but 21 publications cited more than one reason):
  - To improve local waste sorting policies or practices (74%)
  - To reduce waste generation (45%)
  - To inform regulatory policy development (42%)
  - To increase or implement waste diversion (34%)
  - To save money on waste costs (31%)
  - Over 30 additional reasons identified including: quantifying greenhouse gas emissions, gathering inputs for LCA, creating waste prediction model, and quantifying total amounts of wastes
- Quantifying waste generation can provide the robust data that is currently lacking to enable effective implementation of waste reduction strategies at the financial, logistical, and legal levels.

Animated slide

# Waste audits



| | Use-based |
|---|---|
| **Access** | Difficult |
| **Safety risk** | High |
| **Costs** | High |
| **Time duration** | High |
| **Accuracy** | High |
| **Disruption to services** | High |

# Public data-base waste audit
# Starting point: UKCAS document

**Schedule of Accreditation**
issued by
**United Kingdom Accreditation Service**
2 Pine Trees, Chertsey Lane, Staines-Upon-Thames TW18 3HR

UKAS MEDICAL
8610
Accredited to ISO 15189:2022

**NHS Tayside**

**Issue No:** 016 **Issue date:** 02 April 2025

| Medical Microbiology | Contact: Alisson McPherson |
|---|---|
| Ninewells Hospital | Tel: +44 (0)1382 660111 ext. 36718 |
| Ninewells Avenue | E-Mail: alisson.mcpherson@nhs.scot |
| Dundee | Website: http://www.nhstayside.scot.nhs.uk |
| DD1 9SY | |

Testing performed by the Organisation at the locations specified below

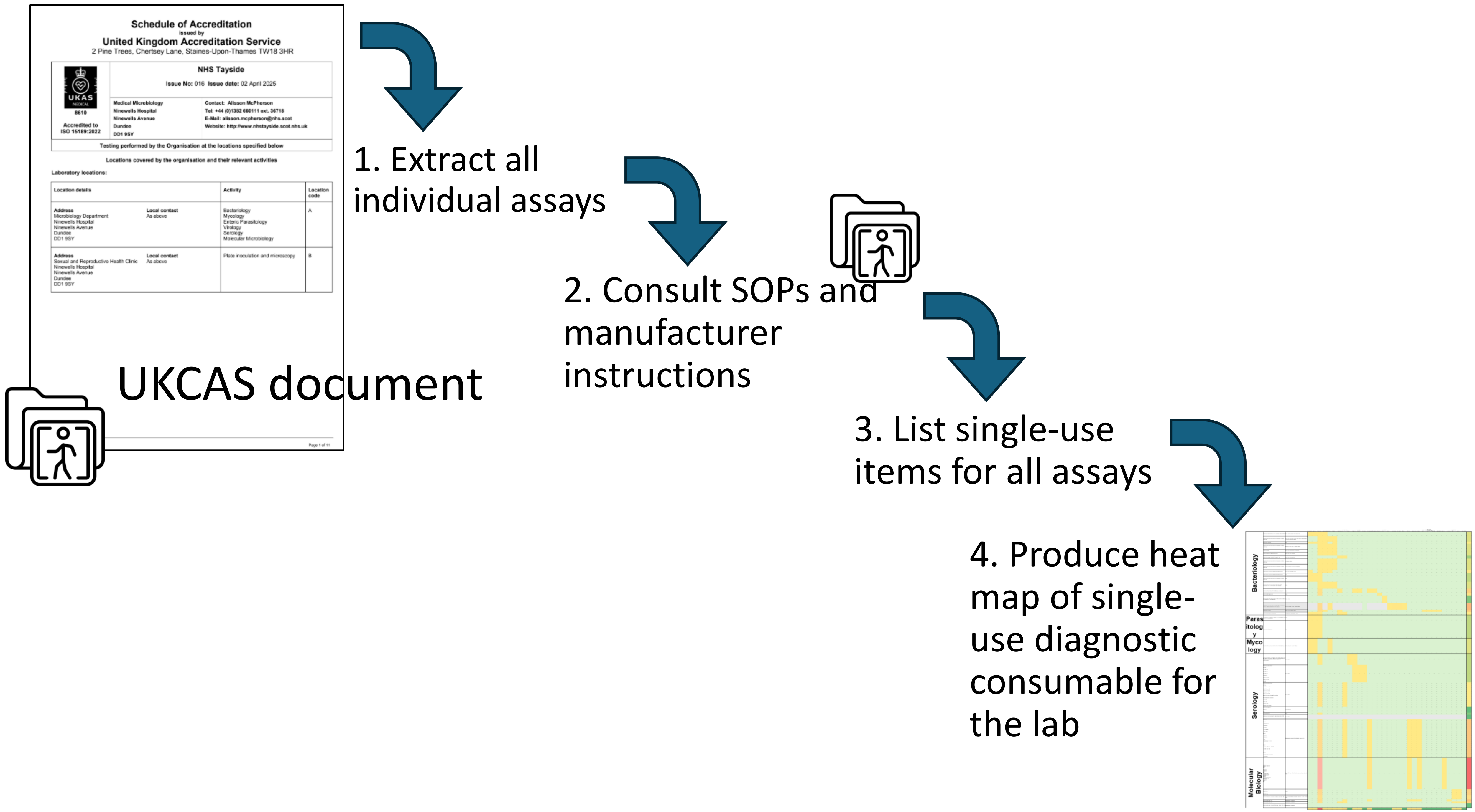
**Locations covered by the organisation and their relevant activities**

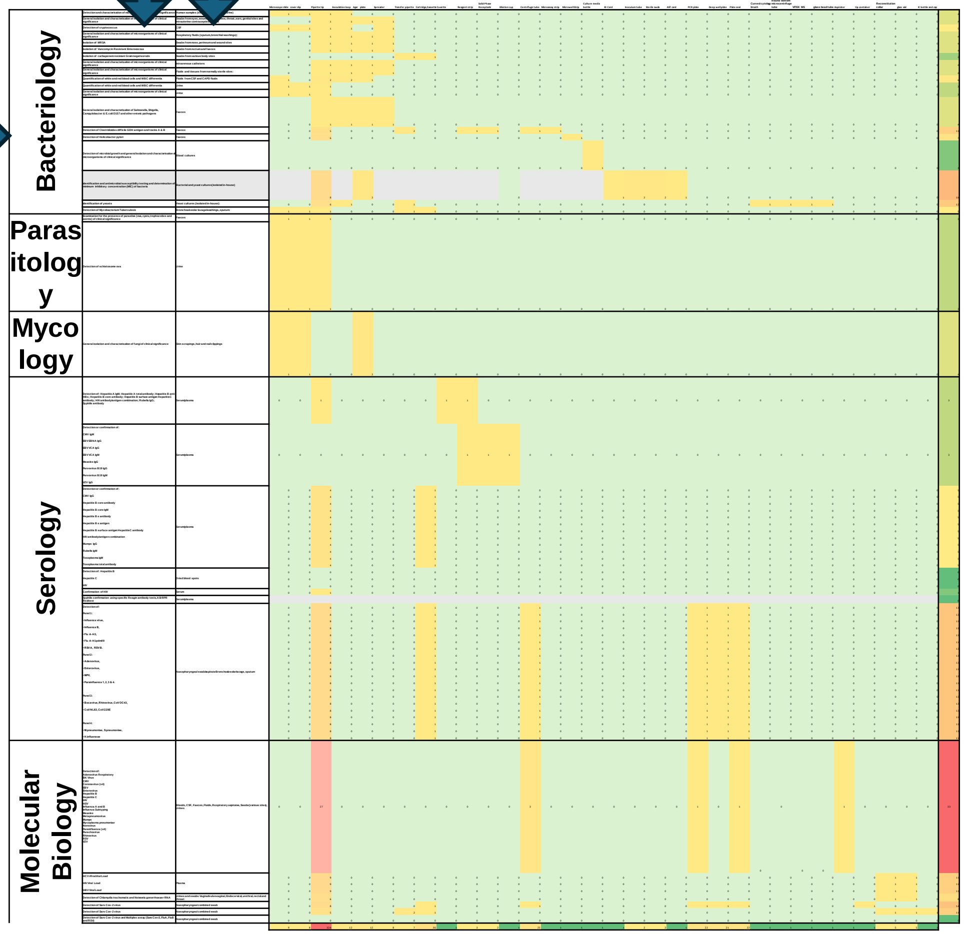
**Laboratory locations:**

| Location details | | Activity | Location code |
|---|---|---|---|
| **Address**<br>Microbiology Department<br>Ninewells Hospital<br>Ninewells Avenue<br>Dundee<br>DD1 9SY | **Local contact**<br>As above | Bacteriology<br>Mycology<br>Enteric Parasitology<br>Virology<br>Serology<br>Molecular Microbiology | A |
| **Address**<br>Sexual and Reproductive Health Clinic<br>Ninewells Hospital<br>Ninewells Avenue<br>Dundee<br>DD1 9SY | **Local contact**<br>As above | Plate inoculation and microscopy | B |



- Public document
- Listing all assays in any UKCAS accredited lab
- Updated every year


Schedule of Accreditation
issued by
United Kingdom Accreditation Service
2 Pine Trees, Chertsey Lane, Staines-Upon-Thames TW18 3HR
NHS Tayside
Issue No: 016 Issue date: 02 April 2025
UKCAS document
1. Extract all individual assays
2. Consult SOPs and manufacturer instructions
3. List single-use items for all assays
4. Produce heat map of single-use diagnostic consumable for the lab
Bacteriology
Parasitology
Mycology
Serology
Molecular Biology




# How to read the heat map table

Bacteriology represents 24% of consumable use

Virology represents 75% of consumable use


Detection of viruses contain the most individual single-use consumables

# Example findings

Pipette tips are the single most present consumable across all

HERIOT WATT UNIVERSITY
THE UNIVERSITY of EDINBURGH
Abertay University
University of Dundee

# Key lessons (1)

- Accessing physical waste is dangerous and time consuming
- Procurement approach has no single information points and can be politically fraught
- This audit format via public documentation enables a non-disruptive assessment of consumables used in any labs, but:
  - Is not suitable for waste management costing
  - does not cover ancillary equipment
  - relies on assay statistics for completeness
- Performs a different goal to Waste Cost Analysis Tool

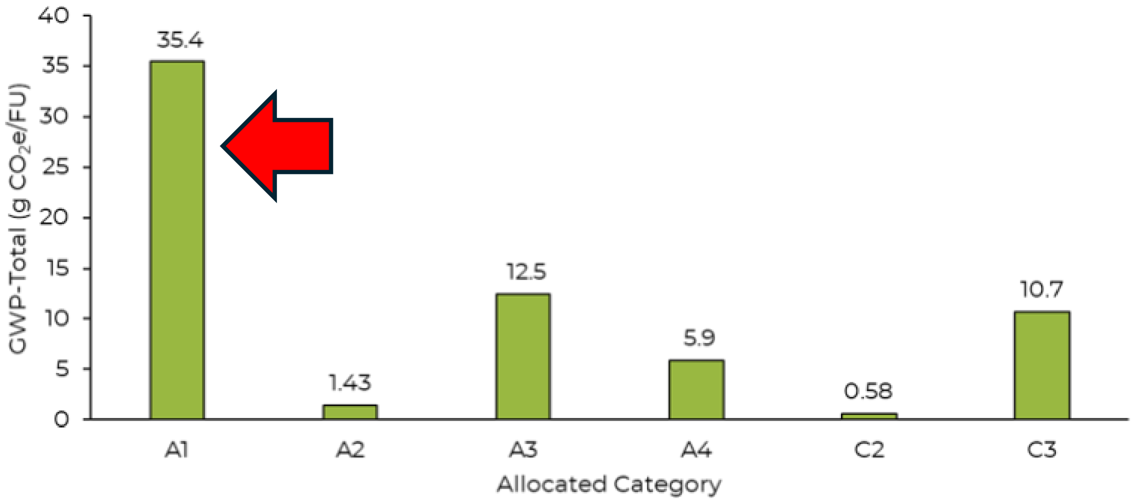
# Key lessons (2)

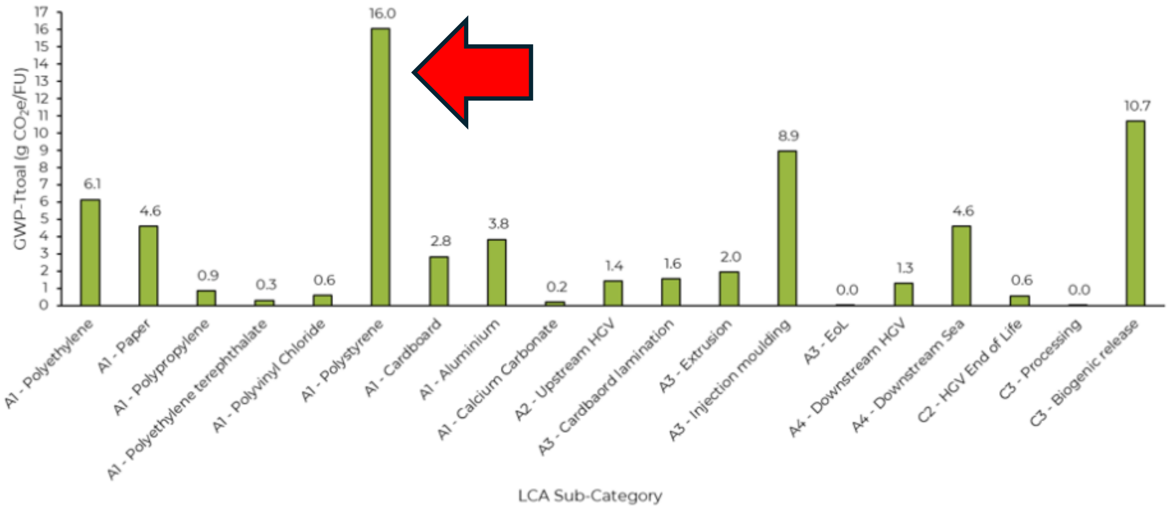
| Purpose & scope | Key features | Potential Impact | Future work |
|---|---|---|---|
| • Develop to enable understanding of waste generation by diagnostic tools<br>• Comparison of diagnostic tools<br>• Manufacturer agnostic<br>• Not for financial costing, although could be paired | • *Currently not operational*<br>• Concept tested on one lab in Scotland only<br>• Enable researchers to understand waste generated by assays | • Support research in diagnostic waste<br>• Support lobbying manufacturers and policy makers for more sustainable products and sustainable targets | • Web-based platform development<br>• Test in different countries<br>• Test against 'use-base' audits |

Take our short survey on our proposed ‘public data’ waste audit for diagnostic lab

# Introducing sustainable materials in diagnostic testing

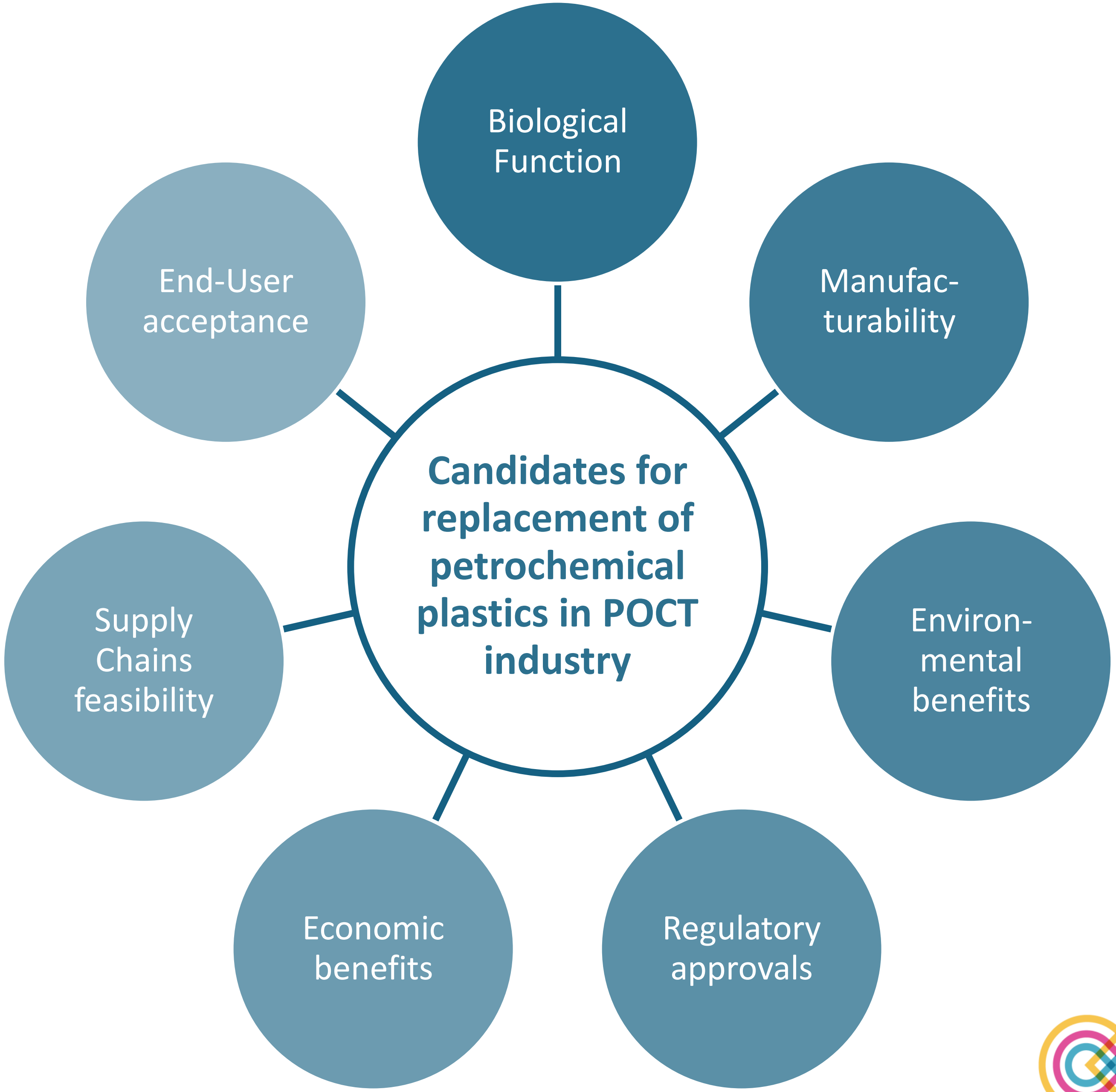
- Purpose: Lower environmental impact of POCTs




- Solution: Replacing virgin petrochemical plastics, starting by the cassette

# Introducing sustainable materials in diagnostic testing



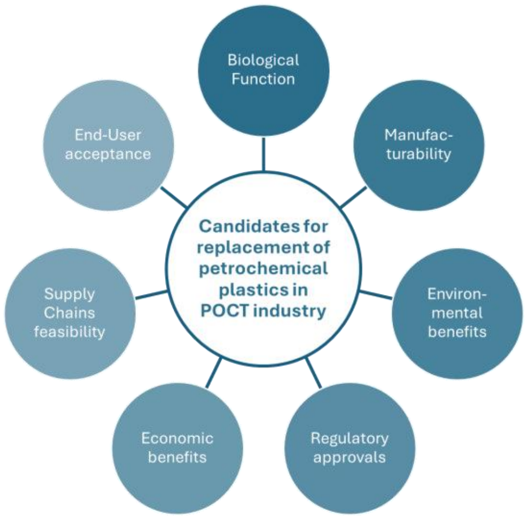

HERIOT WATT UNIVERSITY

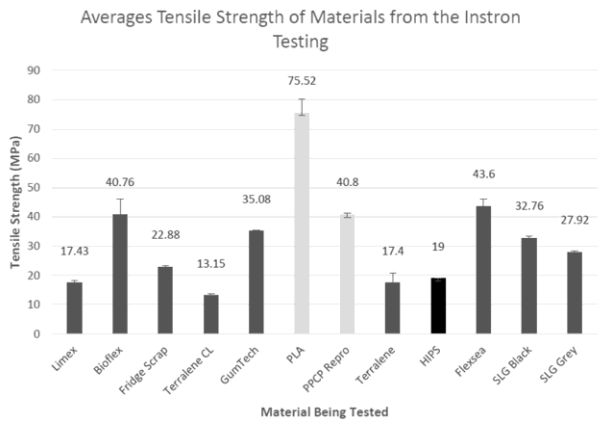
THE ROYAL SOCIETY

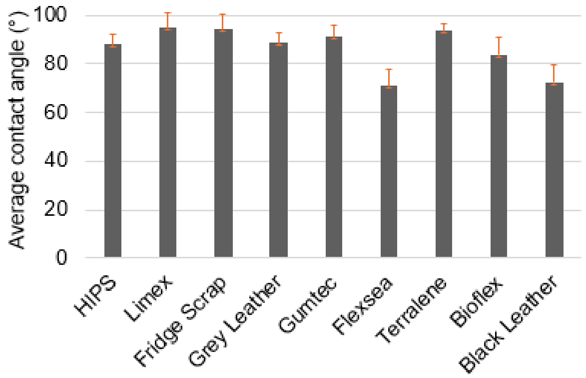
THE UNIVERSITY of EDINBURGH

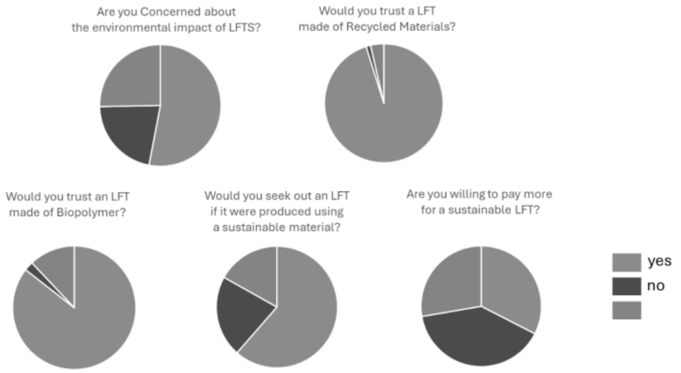
After the Single Use
Rethinking Plastics in Healthcare

# ‘Conversation starters’




| | Manufacturing | | Environmental Impact | Engineering | | Functional | Supply chain | Economics | Regulatory | End users |
|---|---|---|---|---|---|---|---|---|---|---|
| | Moulding | Printing | | Mechanical testing | | Biological testing | | | | Social Opinions |
| | | | | Tensile strength | Contact angle | | | | | |
| Re-HIPS | | | | | | | | | | |
| Bioflex | | | | | | | | | | |
| Gumtec | | | | | | | | | | |
| Limex | | | | | | | | | | |
| Terralene | | | | | | | | | | |
| Black leather | | | | | | | | | | |
| Grey leather | | | | | | | | | | |
| Flexsea | | | | | | | | | | |

# Introducing sustainable materials in diagnostic testing : Key lessons

| Purpose & scope | Key features | Potential Impact | Future work |
| --- | --- | --- | --- |
| • Lower environmental footprint of POCTs | • Comparison of various ‘alternative’ materials<br>• Prototypes/ ‘Conversations Starters’ | • Lower POCT Sector Carbon Emissions and environmental impact<br>• Support lobbying manufacturers and policy makers for more sustainable products and sustainable targets | • Full parametric LCA<br>• Full manufacturing tests<br>• Full regulatory approval |

# Conclusions

- Reducing waste is an environmental priority
- Reducing waste needs to be tackled holistically, by coalition of manufacturers, policy-makers, approved bodies in consultation with end-users
- Collaborations welcomed

THE UNIVERSITY of EDINBURGH

HERIOT WATT UNIVERSITY

# Tools for change: Quantifying and Understanding Diagnostic Plastic Waste

*Alice Street*

*Maïwenn Kersaudy-Kerhoas*

ASLM Waste Sub-CoP session
24th March 2026

ASLM
AFRICAN SOCIETY FOR LABORATORY MEDICINE


Photograph: Courtesy Collins Otieno, ASLM

## MATERIALS, DESIGN & REAGENTS

**Alternative to virgin plastics:**
Recycled plastics, natural products: paper, dry cellulose, cardboard, wood pulp

**0% toxic gases during waste disposal**
Control over plastic additives and reagents

**Eco-design**
Single plastic solution for greater recyclability, where possible

**Upcycled/re-usable components**

**0% toxic reagents**
Novel DNA extraction and non-chemical lysis will enable a new generation of sustainable POCTs

## PROCESSES

**Local manufacturing**

**LCA at design stage**

**End-user involvement**

**Manufacturer take-back schemes**

## REGULATIONS

**Recycling signage on medical devices**

**Environmental sustainability requirements in TPPs**

## PROCUREMENT

**Guidance on carbon footprint measurements**

**Environ-mental criteria in procurement**

## ECONOMICS

**Cost of material or processes changes**

**Cost of regulatory approvals for new materials**