**Making the case for Prefilled Syringes (PFS): Development and utilisation of an economic model**

**Background and Importance**
- Parenteral medication is primarily supplied via conventional vial or ampoule and syringe in hospital settings (conventional delivery).
- Prefilled syringes (PFS) may offer economic and clinical advantages including reductions in preventable adverse drug events (pADEs), drug waste, and supply costs, while increasing workflow efficiencies.
- A German medical record-based study found that a single pADE resulting from a medication error costs the health system an additional €97.7
- Conventional delivery methods are associated with drug wastage. One study found that 85% of all atropine doses, a medication used to reduce secretions in the airway during surgery, are discarded.4
- PFS utilisation reduces the number of steps required to deliver medication such as extracting medication from the vial. This reduces time spent to prepare the injection, supply costs and potential contamination.5,6
- Previous economic models have shown the benefits of converting from vials and ampoules to PFS (denoted as “vials to pre-filled” (V2P); however, these models are country-specific and limit generalisability of findings.

**Aim and Objectives**
- An economic model was developed to determine the annual potential impact of switching from vials/ampoules to PFS.
- To create a tool for use across acute and emergency clinical settings.

**Materials and Methods**
- The Excel-based economic model was developed to calculate the potential impact of switching from vials/ampoules to PFS. The four key outcomes were: pADE rates, labour time efficiency, unused drug, and cost of supplies. As shown in Figure 1.
- pADE rates: The rate of preventable adverse drug events that result from medication errors including administering the wrong dose of a drug, administering the wrong drug, or at the wrong time.
- Labour time efficiency: Calculated as the time it takes for hospital staff to prepare a dose of medication for delivery from a vial or ampoule and for PFS format.
- Unused drug: Doses that are prepared but not used and need to be discarded.
- Cost of supplies: Supply costs are based on UK National Health Service Tariff data and include nitrile gloves, sterile single-use hypodermic needles, 1.0mL syringe and needle, skin prep, and wipes.
- Defaults used in the model were derived from peer-reviewed literature sources, and national datasets.

A hypothetical case-study, which involved the administration of 35 doses of atropine/ day in a UK cardiac intensive care unit, was developed to investigate the model utility. Defaults included:
- Drug cost: £0.82/vial; and dose and £0.03/PFS dose2
- pADE rates: 1.39 and 0.73 for vials and PFS, respectively, per 100 administrations for vials and PFS, respectively.
- Incremental hospital cost per pADE: £791.61
- Unused drug: 85% for vials and 0% for PFS
- Labour times: 40.3 seconds for vials and 16.9 seconds for PFS
- Supply costs (per unit injection): £0.60 for vials and £0.19 for PFS

**Results**
- In the hypothetical case study, the annual V2P cost savings associated with reductions in pADEs, unused drug, and costs of supplies were £66,173, £59,361, and £2,667, respectively.
- While the annual cost of PFS was £53,783 greater than vials, the net budget savings of V2P was £74,419 per year.
- Preparation time decreased 893 hours per year.

**Conclusion and Relevance**
- Limitations include:
  - The model is simplified to include the four main domains that impact switching to PFS. Factors that may influence costs of V2P from a global perspective, including microbial contamination risks, costs of sharps disposal, and storage costs and requirements for PFS are not included in the model.
  - Given variation of labour time efficiency in the literature, this model input is likely underestimated, as the model utilizes a lower-end estimate.
  - UK-specific data was not available for pADE rates, pADE costs, and wastage rates. Costs were converted from euros to GBP via purchasing power parity (PPP).
- This model is user-friendly, customizable and allows hospitals in any country to quantify the clinical and economic value of switching from vials to PFS.
- In the hypothetical case study although switching from atropine ampoules to PFS was associated with an increased cost per dose with PFS, PFS use showed net budget savings due to fewer pADEs and reduced drug wastage as well as staff efficiency savings due to reduced prep time.
- This model may be used as a decision support tool for hospital decision-makers considering switching from conventional to prefilled formats as it is customizable and includes considerations beyond the acquisition price.

**Table 1: Model Output: Case Study Results**

<table>
<thead>
<tr>
<th>Model Output</th>
<th>Case Study</th>
<th>Vials</th>
<th>PFS</th>
<th>Incremental Difference</th>
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<tbody>
<tr>
<td>Number</td>
<td>577</td>
<td>64</td>
<td>84</td>
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<tr>
<td>Cost</td>
<td>£76,566</td>
<td>£78,321</td>
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<td>Hospital Drug (per year)</td>
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<td>-</td>
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<tr>
<td>Total number of dose-unit</td>
<td>72,282</td>
<td>72,282</td>
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<td>Cost of administered dose</td>
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<td>Drug Cost (per year)</td>
<td>£79,476</td>
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<td>Syringe per cent Injection</td>
<td>65.04%</td>
<td>62.04%</td>
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<td>Labour Cost (per year)</td>
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<td>Total Overall Cost</td>
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</tr>
</tbody>
</table>

**Figure 1: V2P Economic Model Structure and Flow**

**Figure 2: Case Study Results: Cost and Efficiency Savings**

**References**
4. Alkemi LLC, Manchester, VT, USA
5. Becton, Dickinson, and Company, Le Pont-de-Claix, France