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

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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 (pADE), 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 €970.[2]
- 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.[3]
- 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.[4,5,6]
- 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 generalizability 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, and administering the drug 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 do not get used and need to be discarded.
  - Cost of supplies: Supply costs are based on UK National Health Service Tarif data and include nitrile gloves, sterile single-use hypodermic needles, 1.0mL syringe and needle and skin prep 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 costs: £0.82/ampoule dose and £5.03/PFS dose[1]
  - pADE rates: 1.39 and 0.73 pADEs per 100 administrations for vials and PFS, respectively[7]
  - Incremental hospital cost per pADE: £791.61[3]
  - Unused drug: 85% for vials and 0% for PFS[2]
  - Labour times: 40.3 seconds for vials and 16.9 seconds for PFS[4]
  - Supply costs (per unit injection): £0.40 for vials and £0.19 for PFS[8]

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.
- The biggest drivers of cost savings in the hypothetical case study were the reduction in unused drug and avoided preventable adverse events, which offset purchase cost of PFS. *As shown in Table 1 and Figure 2.*

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.

Figure 1: V2P Economic Model Structure and Flow

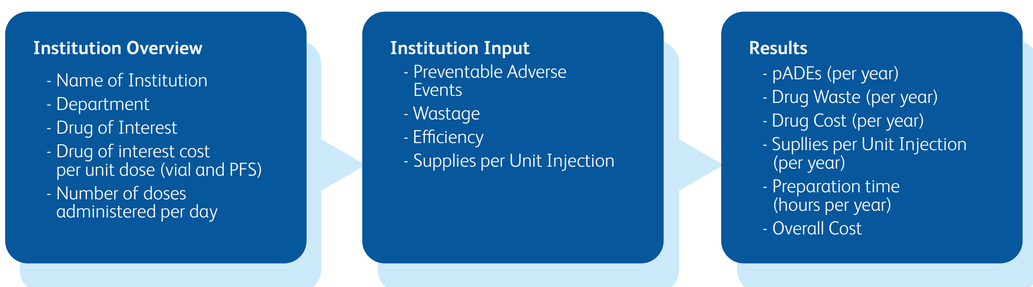

Figure 2: Case Study Results: Cost and Efficiency Savings

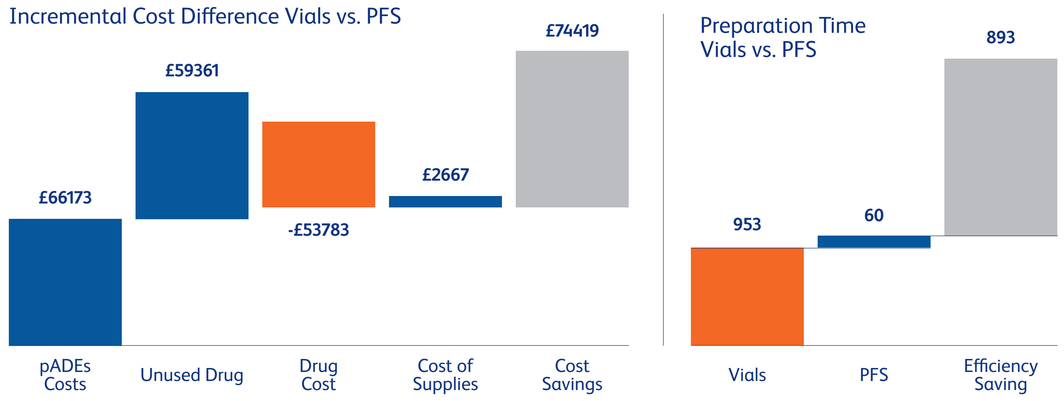

Table 1: Model Output: Case Study Results

Model Output	Case study		
	Vials	PFS	Incremental Difference
pADEs (per year)			
- Number	177	94	84
- Cost	£140,494	£74,321	£66,173
Unused Drug (per year)			
- Total number of doses unused	72,392	-	72,392
- Cost of unused doses	£59,361	-	£59,361
Drug Cost (per year)			
- Cost of administered doses	£10,476	£64,258	£53,783
Supplies per Unit Injection			
- Cost per year	£5,054	£2,386	£2,667
Preparation time			
- Hours per year	953	60	893
Total Overall Cost	£215,385	£140,966	£74,419

Disclosure:

Haymen Girgis, MD PhD, Mia Weiss, MPH and Tyler Edwards, PharmD are BD employees

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