Cost-Effectiveness of Vaccination Strategies to Control Future Mpox Outbreaks in England

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BACKGROUND

- In May 2022, mpox transmission was identified among gay, bisexual, and other men who have sex with men (GBMSM) in England. Vaccination stands as a key public health measure for controlling mpox.
- Efforts were made to promote vaccine uptake, particularly among high-risk GBMSM. A proposal under consideration by The Joint Committee on Vaccination and Immunisation (JCVI) is reviewing the need for a mpox routine (pre-emptive) versus reactive (outbreak response) immunization strategy, following the outbreak response vaccination in 2022[1].
- Understanding the epidemiology and planning on cost-effectiveness of vaccination strategies is crucial for controlling future outbreaks in England.

OBJECTIVE

To determine the most cost-effective vaccination strategy for reducing the likelihood of future outbreaks of mpox among GBMSM in England, following the 2022 outbreak

METHODS

- A validated compartmental model, costs and outcomes of mpox transmission and vaccination was projected over a 20-year period, with 3.5% annual discount.
- The cost-effectiveness threshold was set at <£20,000/QALY at 50% of runs and <£30,000/QALY at 90% of runs, in line with UK vaccine policy [2].

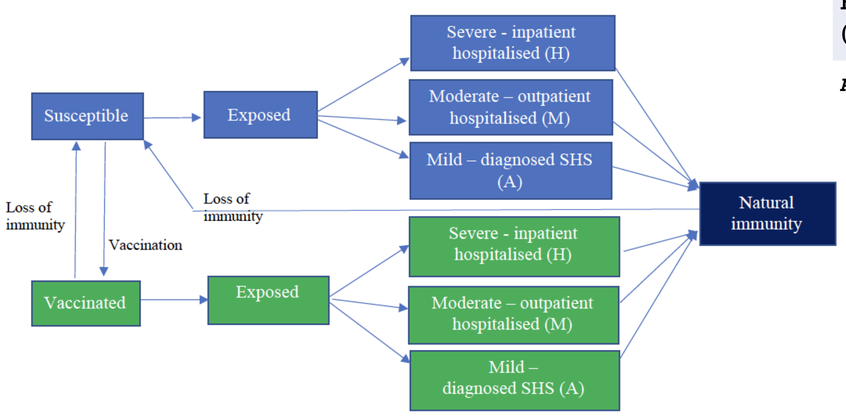

Figure 1: Simplified schematic of model

- The model considered vaccination's impact on mpox transmission using surveillance data from the 2022 outbreak and a GBMSM survey (RiiSH-MPOX) in December 2021.
- Different vaccination rates and coverages for reactive and pre-emptive vaccination strategies were compared to no vaccination, targeting high-risk GBMSM.
- Probabilistic sensitivity analysis was applied, assuming vaccine protection for 10 or 5 years with effectiveness rates of 78% and 89% for 1 and 2 doses [3, 4].
- Cost inputs were derived from UKHSA, NHS standard costs, or mpox-specific tariffs, adopting a healthcare perspective.
- QALYs per year were adapted from the Global Burden of Disease study and herpes zoster utilities.

Acknowledgement

Many people from UKHSA, NHS and NHS-England. Claire Dewsnap, David Phillips, and Mike Beadsworth

References

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2. Department of Health & Social Care and Immunisation and High Consequence Infectious Diseases Team, Global and Public Health Group. Consultation on the Cost-Effectiveness Methodology for Vaccination Programmes and Procurement (CEMIPP) Report.
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4. Xu, M. et al. (2023) 'Real-world effectiveness of Monkeypox Vaccines: A systematic review', Journal of Travel Medicine, 30(5). doi:10.1093/jtm/taad048.

RESULTS

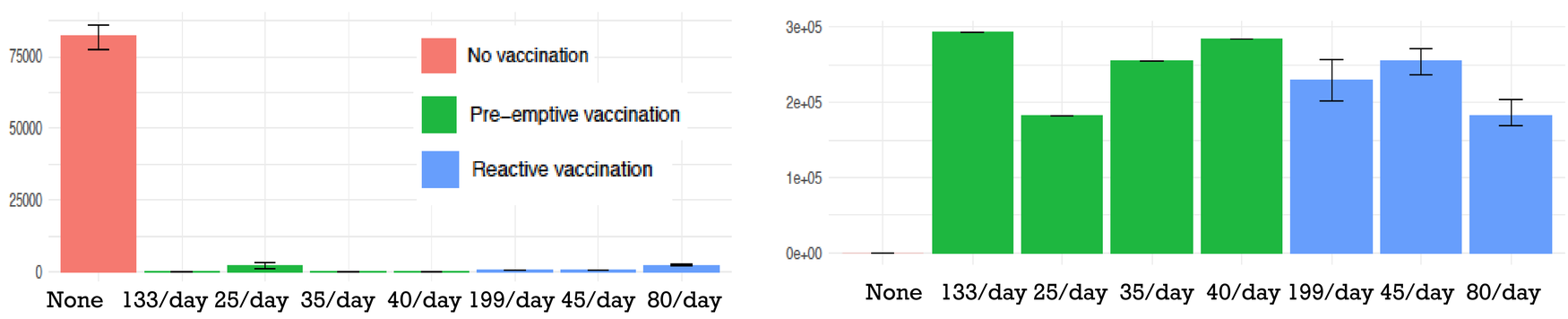

Figure 2: Overall impact of different vaccination strategies

Table 1: Base-case cost-effectiveness results (compared to no vaccination strategy)

Scenario	Incremental costs with PHR (£, 2022)	Incremental costs no PHR (£, 2022)	Incremental QALYs	ICER with PHR (£, 2022)	ICER no PHR (£, 2022)
Reactive 80 per day (30% in year)	-45,727,299	-7,789,713	808	Cost-saving	Cost-saving; **Dominates**
Pre-emptive 25 per day	-50,910,626	-6,551,889	816	Cost-saving	Cost-saving
Reactive 451 per day (as in 2022)	-49,371,042	878,912	822	Cost-saving	£1,069
Reactive 199 per day (75% in year)	-49,048,736	-2,244,976	822	Cost-saving	Cost-saving
Pre-emptive 35 per day	-53,643,094	2,068,298	841	Cost-saving: **Dominates**	£2,459
Pre-emptive 133 per day (50% in year)	-48,906,027	6,805,365	845	Cost-saving	£8,053

Abbreviations: PHR, public health response, ICER, incremental cost-effectiveness ratio; QALY, quality-adjusted life year.

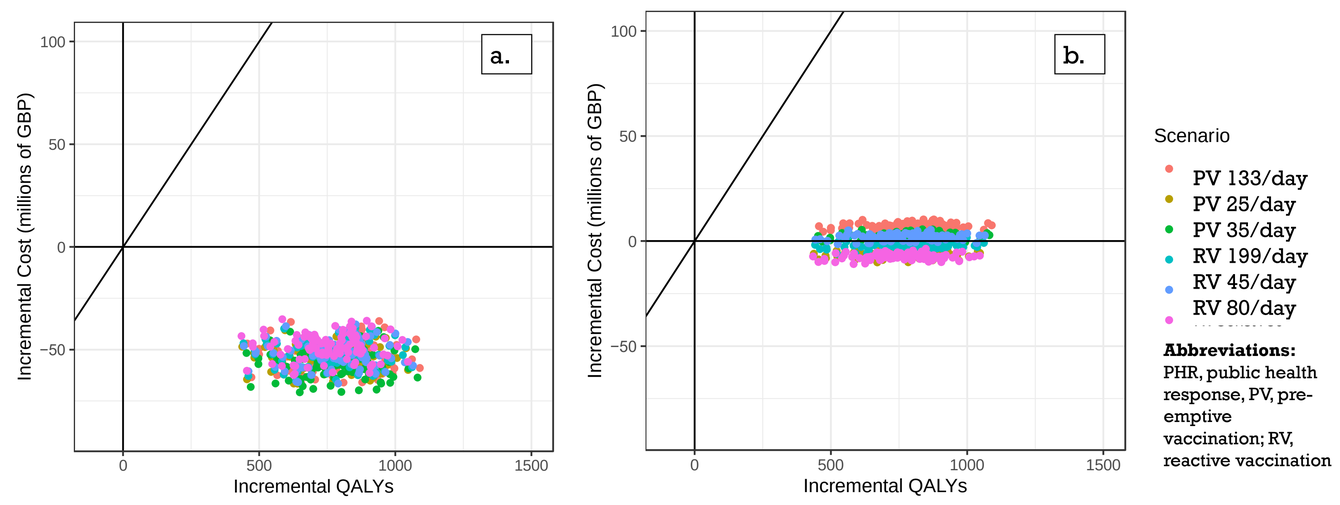

Figure 2: Cost-effectiveness plane a) with PHR costs, b) without PHR costs

DISCUSSION

- Assuming vaccine duration of protections were 10 years for 2 doses (89% effectiveness) and 5 years for 1 dose (78% effectiveness), any vaccination strategy reduced outbreak size and duration. Pre-emptive vaccination prevented outbreaks, while reactive vaccination strategies reduced infections to low levels.
- All vaccination strategies with public health response (PHR) costs were cost-saving compared to no vaccination. Pre-emptive vaccination with a low rate was the best strategy if PHR costs were included. However, without PHR costs, reactive vaccination with a low rate was cost-saving.
- The characteristics of the vaccine under consideration present several uncertainties, with potential variations in efficacy and the duration of protection is also uncertain.
- Similar uncertainties surround immunity post-infection, and questions arise about the severity of breakthrough infections because the cost-effectiveness outcomes were driven by vaccine efficacy and PHR costs.
- QALY utility values for mpox are currently unavailable, and death as an outcome is excluded based on no reported of such occurrences in England.
- Improvements are needed in incorporating accurate data regarding illness duration at various severity levels. Additionally, uncertainties persist regarding the triggers for initiating and concluding outbreak responses, impacting associated costs. The link between future risk behavior reduction and PHR cost is assumed to be uncertain and not established.

CONCLUSIONS

Vaccinating high-risk GBMSM against mpox is superior to no vaccination. Pre-emptive vaccination is preferred if PHR costs are included; reactive vaccination is favoured with no PHR costs. Further studies should address the robustness of vaccine efficacy and data on PHR costs.