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

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BACKGROUND

- In 2022, a global mpox outbreak occurred among **gay and bisexual men who have sex with men (GBMSM).**
- In England, the outbreak was controlled through reductions in sexual risk behaviour and vaccination of high-risk GBMSM.
- However, mpox continues to circulate, including an expanding outbreak in Africa.
- This raises the concern that future outbreaks could occur especially if population immunity levels decrease
- **We evaluated the most cost-effective vaccination strategy to minimise future mpox outbreaks among GBMSM in England.**

METHODS

- **An existing dynamic mathematical model of mpox transmission among GBMSM[1] was utilised** :
  - Stratified GBMSM into low and high risk for mpox (< or ≥10 sex partners in last four months)[2]
  - Split disease into severe (inpatient; 6.1% of cases), moderate (outpatient; 8.3%) and mild (the rest) mpox
  - Calibrated in Bayesian framework to the 2022 outbreak in England
- **Health provider perspective used to estimate costs based on 2022 outbreak**:
  - Clinical case management
  - Administering the vaccine
  - Public health response (PHR) during outbreaks
- **Incremental cost-effectiveness ratio (costs per QALY gained) was estimated for different vaccination strategies** from 2024 targeting high-risk GBMSM:
  1. Reactive vaccination (only during outbreaks) - **RV**
  2. Pre-emptive vaccination (continuous routine) - **PV**
  3. Combination of reactive and pre-emptive
  - All compared to no vaccination
- **Analysis assumptions**:
  - 20-year time-horizon, 3.5% discount rate
  - Willingness-to-pay threshold of £20,000/QALY.
  - Importation of new mpox cases at 6 per month,
  - Vaccine effectiveness of 78%/89% for 5/10 years following 1 or 2 doses
  - Vaccine cost £160 per dose

Routine vaccination of high-risk GBMSM likely to be cost-saving for minimising future Mpox outbreaks.

RESULTS

- **All vaccination strategies gained QALYs and saved costs compared to no vaccination**. Example costs and impact projections in Table 1:

Table 1: A comparison of costs and QALYs for two vaccination scenarios compared to no vaccination for 2024-2044

Scenario	Vaccination	Clinical case management	PHR	Total costs	QALYs	Incremental QALYs
No vaccination	£0	£21,718,000	£59,663,000	£81,382,000	9,493,847	-
Pre-emptive (135/day – 50% coverage in year)	£42,436,000	£2,254,000	£2,975,000	£47,666,000	9,494,345	498
Reactive (465/day – vaccination rate in 2022 outbreak)	£37,914,000	£2,496,000	£9,892,000	£50,301,000	9,494,339	492

- **Continuous pre-emptive vaccination (PV daily rate 27 doses) with reactive vaccination (RV daily rate 135 doses) if there is an outbreak was most cost-effective:**
  - All other vaccination scenarios either save less QALYs or have an ICER above £20,000/QALY gained compared to this scenario (see Table 2).

Table 2: Vaccination scenarios in order of increasing costs for undertaking a full incremental cost-effectiveness analysis

Scenario	Incremental costs	Incremental QALYs	ICER
PV at 27 per day; RV at 135 per day	**-£36,316,000**	**492**	**Cost-saving – lowest cost scenario**
PV at 27 per day; RV at 204 per day	-£35,991,000	494	Cost-saving – £176,630/QALY compared to PV27RV135
PV at 27 per day; RV at 81 per day	-£35,670,000	490	Cost-saving – Dominated
PV at 41 per day	-£34,634,000	496	Extendedly dominated
PV at 41 per day; RV at 81 per day	-£34,503,000	497	£480,000/QALY compared to PV27RV204

- Threshold analysis shows vaccination remains cost-effective if vaccine costs < £576/dose.
- **Pre-emptive with reactive vaccination remains the preferred strategy across most sensitivity analyses**, including for importation of more severe clades,
- **Optimal vaccination strategy can change to**:
  - Just reactive vaccination when Public Health Response costs are not included,
  - Just pre-emptive vaccination when fractional doses are used, there is no reduction in risk behaviour during outbreaks, or there is a higher importation rate of new cases.

CONCLUSIONS

Findings suggest vaccinating for mpox better than not vaccinating among high risk GBMSM

- Reduces costs considerably and saves QALYs
- Is cost-effective unless vaccine is expensive (>£600 per dose)
- Combined strategy of pre-emptive vaccination at low vaccination rate with higher vaccination rate during outbreaks is likely best strategy

Although many uncertainties, sensitivity analyses suggest results are robust except in certain situations

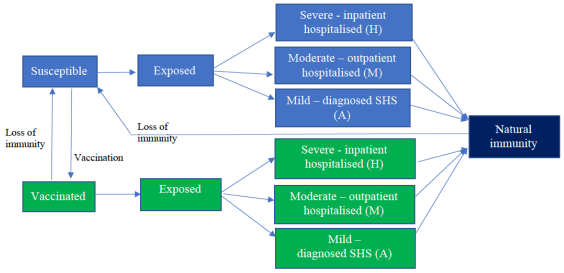
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References

1. Zhang et al. Lancet Infectious Diseases 2023;

Figure 1 Schematic of the mpox transmission model among GBMSM for assessing the impact and cost-effectiveness of different future vaccination scenarios.



Stratification by low and high risk for mpox infection is not shown, and vaccination is only shown as one stratification although there are stratifications for 1 or 2 doses of vaccine in the model.