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EVALUATING THE USE OF DOSE-SPARING VACCINATION STRATEGIES FOR MONKEYPOX

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BACKGROUND

The spring-summer 2022 monkeypox outbreak had over 50,000 cases globally, most of them in gay, bisexual, and other men who have sex with men (MSM). In response to vaccine shortages, several countries implemented dose-sparing vaccination strategies, stretching a full-dose vaccine vial in up to 5 fractional-dose vaccines. Recent studies have found mixed results regarding the effectiveness of the monkeypox vaccine, raising the question of the utility of dose-sparing strategies.

METHODS

- We used an age- and risk-stratified mathematical model of an urban MSM population in the United States with approximately 12% high-risk MSM to evaluate potential benefits from implementing dose-sparing vaccination strategies in which a full dose is divided in 3.5 fractional-doses.
- We simulated vaccination campaigns over 5 weeks with equal number of MSM vaccinated each week. The high-risk MSM population was prioritized.
- We ran scenarios with 2,500 to 10,000 full-doses available, assuming no delay, 5-weeks or 10 -weeks delay of vaccination and exploring fractional-dose vaccine efficacy (VE) ranging from 17% (20% of the full dose VE) to 85% (100% of the full dose VE).
- We assumed that vaccination do not affect the course of breakthrough infections of their infectiousness.

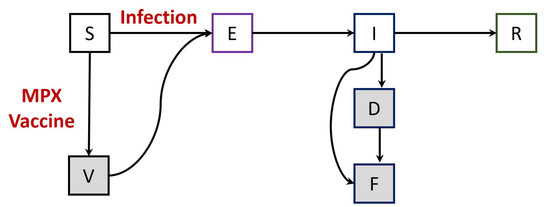

Figure 1. Model diagram showing Monkeypox transmission dynamics. MSM who become sexually active join the susceptible compartment (S) at constant rate who can then be vaccinated (V). Upon infection susceptible MSM initially move to an exposed (E) but not infectious class before becoming infectious (I) and recover (R). Infectious individuals (I) may also be diagnosed (D) and die (F) at rates independent of vaccination status. Population is additionally stratified by age, risk and sexual positioning.

Dose-sparing vaccination may be a viable public-health policy when monkeypox vaccine supply is limited and fractional-dose vaccine retains at least moderate effectiveness

RESULTS

- Our base-case scenario without vaccination resulted on average in 11, 330 cumulative infections over 6 months with a maximum of 1126 infections weekly.
- When a **limited number of vaccine vials** were available (2,500 vaccine vials), sufficient to vaccinate 31% of the high-risk population, then **a dose-sparing strategy prevented more infections compared to full-dose vaccination** as long as the fractional-dose retained 40% of the effectiveness of a full dose.
- In contrast, if **7,500 vaccine vials** were available (enough to cover 94% of the high-risk population), then **full-dose campaigns were projected to outperform dose-sparing campaigns** with low fractional-dose VE (34%).

	Full-Dose	Dose-Sparing Vaccination Strategy (% Incremental difference compared to full-dose)	
Population size of men who have sex with men [number high risk]	65,000 [7924]		
Number of high-risk people vaccinated	2500	8,750 (+250%)	
Vaccine effectiveness (VE)	85%	Low VE 34%	High VE 68%
Peak weekly number of new MPX infections over 6 months	745	736 (-1.2%)	170 (-77.1%)
Cumulative number of new MPX infections over 6 months	5424	4743 (-12.6%)	1679 (-69.0%)
Number of people vaccinated	7,500	26,250 (+250%)	
Vaccine effectiveness (VE)	85%	Low VE 34%	High VE 68%
Peak weekly number of new MPX infections over 6 months	115	655 (+465%)	122 (+5.3%)
Cumulative number of new MPX infections over 6 months	1420	4147 (+193%)	1358 (-4.3%)

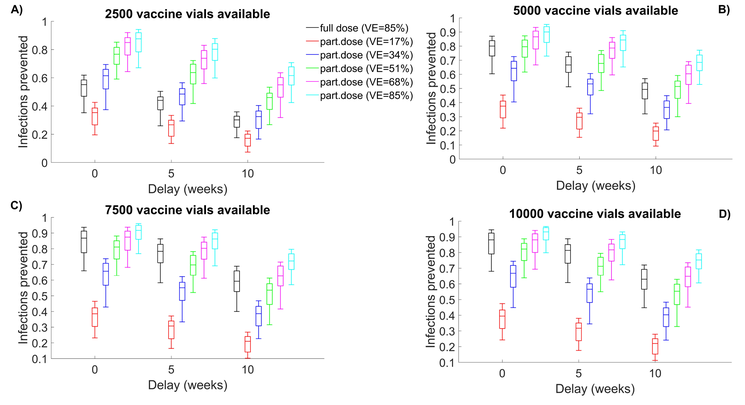

Figure 2. Proportion of infections prevented for A. 2,500, B. 5000, C, 7,500 or D. 10,000 vaccine vials available compared to base-case scenario without vaccination. For each panel, we showed vaccination with full-dose (VE=85%) and fractional-dose VE, ranging from 17% to 85%. We compared immediate vaccination to delayed vaccination starting 5 or 10 weeks after the first infection was identified.

INTERPRETATION

- When monkeypox vaccine supply is limited, there is a threshold in the fractional dose VE above which it is expected to prevent more infections than full-dose vaccination.
- As a greater supply of vaccine becomes available, the threshold for fractional-dose VE needed to outperform full-dose vaccination increases: with 2500 vials the threshold is below 40% of full VE; at 5,000 vials, fractional-dose VE needed to retain at least 60%of full VE (Fig 2A vs. B).
- There is a little gain in the number of infections averted once the available vaccine doses exceeds the size of the high-risk group (Fig 2C vs. D).

CONCLUSIONS

Our analysis suggests that when monkeypox vaccine supply is limited and fractional-dose vaccination retains moderate effectiveness, there are meaningful health benefits from providing a smaller dose to a larger number of people in the high-risk population.

ACKNOWLEDGEMENTS

HPTN HIV Prevention Trials Network · HIV VACCINE TRIALS NETWORK · NSF · INFECTIOUS ECONOMICS

Presented at CROI Seattle 2023 Corresponding author: ddimitro@fredhutch.org