Public Health Implications of Limited Varicella Vaccination Coverage

DR SEYED MOHSEN ZAHRAEI

PROFESSOR OF INFECTIOUS DISEASE

DIRECTOR OF VACCINE PREVENTABLE DISEASE

CENTER FOR COMMUNICABLE DISEASE CONTROL

Introduction

- Varicella (chickenpox) is generally mild in children but more severe in adolescents and adults.
- Vaccines are available and effective, but not universally implemented.
- Objective: To explore how low vaccination coverage can alter disease epidemiology and increase risk in older age groups.

Key Concepts

- **Age Shift**: Reduction in childhood infection due to partial vaccination leads to higher average age at infection.
- **Higher Risk in Adults**: Adults are 10–20 times more likely to develop severe complications.
- **Public Health Trade-off**: Incomplete coverage can paradoxically increase total disease burden.

WHO Recommendation

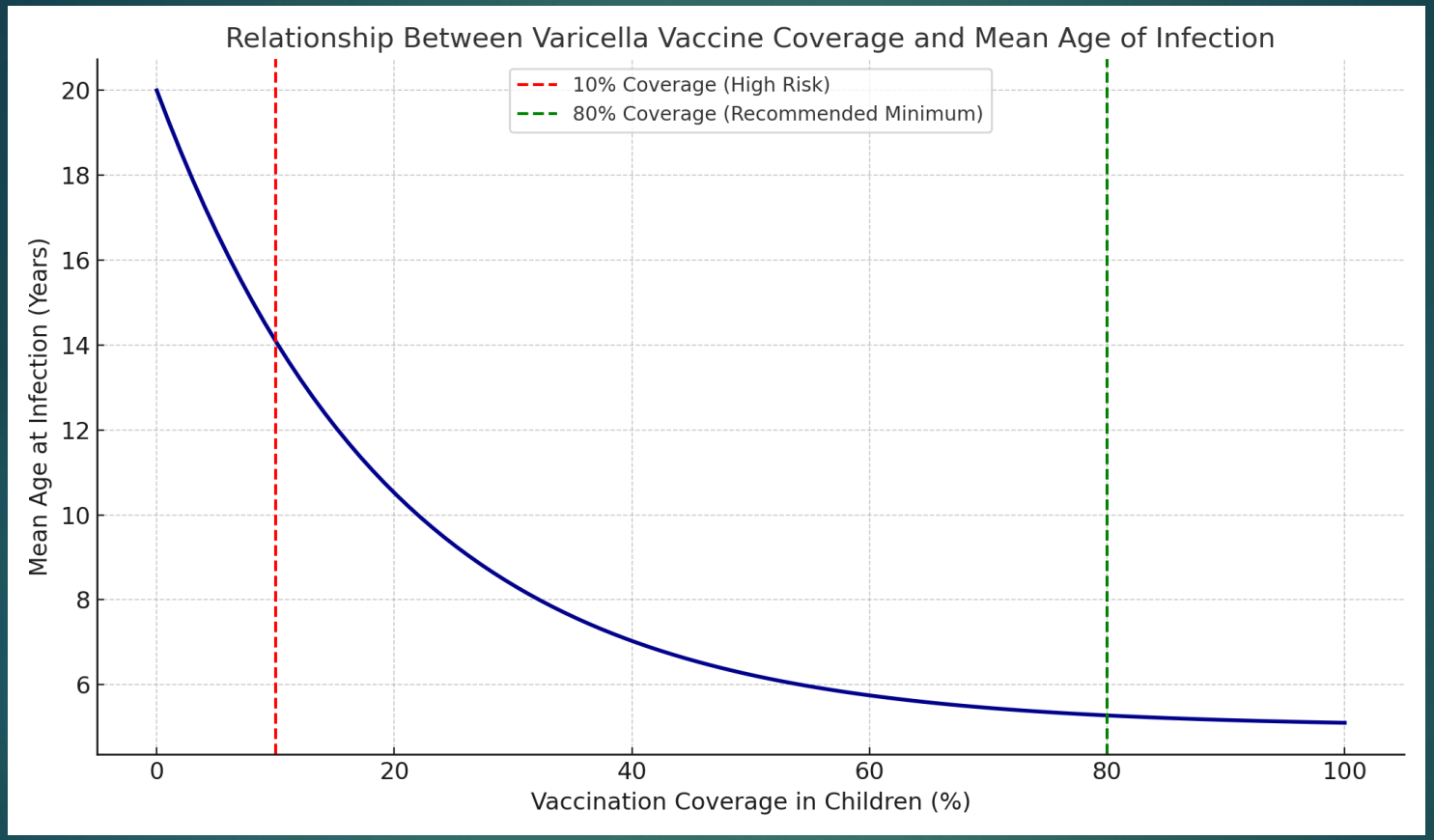
- WHO recommends at least 80% coverage in children if varicella vaccine is introduced.
- Inadequate coverage may lead to:
  - Persistent viral circulation
  - Delayed exposure
  - Increased severe cases in adolescents and adults

Source: *WHO Position Paper on Varicella Vaccines (2014)*

Epidemiological Evidence

- **Germany (Banz et al., 2003):** Partial vaccine uptake shifted average age of infection.
- **US (Seward et al., 2002):** Universal vaccination decreased hospitalizations by 88–97%.
- **Mathematical Models (Garnett & Ferguson, 1996):** Coverage <60% increases average infection age.
- **China and Japan:** Selective programs failed to prevent outbreaks in older age groups.

Modeling the Risk *Model assumption based on exponential decay*



- **Interpretation:**
- Coverage <20% leads to significant increase in age at infection (>15 years)
- Only ≥80% coverage effectively prevents age shift and ensures herd protection

Summary and Implications

- Limited varicella vaccination may increase rather than reduce overall disease burden.
- To avoid age shift and complications:
  - Implement ≥80% routine childhood coverage
  - Monitor age-specific incidence
  - Consider two-dose schedules for sustained protection

Does Low Varicella Vaccination Increase Herpes Zoster?

- Herpes zoster (shingles) occurs due to **reactivation** of latent varicella-zoster virus (VZV) in individuals who have previously had chickenpox. There's a long-standing hypothesis that **exogenous boosting** (i.e., re-exposure to circulating VZV in the community) keeps zoster risk lower in adults.

Theoretical Concern

- If varicella circulation declines due to vaccination, adults are less frequently re-exposed to VZV.
- This **reduced exogenous boosting** might allow latent virus to reactivate more easily, possibly **increasing zoster incidence**, especially in older adults.

What Studies Say

Brisson et al., Epidemiol Infect 2000	Predicted transient increase in zoster after mass varicella vaccination due to less natural boosting.
Gaillat et al., J Infect Dis 2011	Found no major increase in zoster in France despite high vaccination coverage.
Tseng et al., Clin Infect Dis 2009	In US, zoster incidence was already rising before varicella vaccine introduction.
WHO Position Paper (2014)	Concludes evidence is inconclusive, and long-term data do not confirm a consistent rise caused by vaccination.

Conclusion

- While **theoretical models** suggest a possible short-term increase in zoster after widespread varicella vaccination, **real-world data** have not consistently supported this.
- Some increase in shingles incidence may relate more to **population aging**, **improved reporting**, or **other immune factors**.
- Therefore, **low varicella coverage does not protect against zoster** — and may instead **maintain circulation** without truly reducing zoster risk.

Policy Considerations and Public Health Justification for Selective Varicella Vaccination in High-Risk Contacts

- Rather than routine universal vaccination of all children, **selective (targeted) vaccination** focuses on individuals at higher risk—for example, non-immune adults in households with immunocompromised people, pregnant women, health care workers offering the vaccine post-exposure or in a preventive context.

Rationale for Selective Vaccination

Justification	Supporting Evidence
Prevent severe outcomes in vulnerable individuals	Immunocompromised individuals, pregnant women, and neonates are at higher risk for complications like pneumonia, encephalitis, or death. Post-exposure vaccination within 3–5 days is effective in preventing or mitigating disease.
Cost-effective and resource efficient	Economic models in low-burden settings (e.g., parts of Europe) show selective vaccination provides strong health gains per cost compared to universal programs.
Addresses ethical concerns	Prioritizing those at highest risk aligns with public health ethics and equity principles.
Reduces public resistance	Targeted vaccination avoids unnecessary coverage where varicella is considered mild, which may improve public acceptance and reduce hesitancy.

Target Groups for Selective Vaccination

- Non-immune household contacts of **immunocompromised patients**
- Children with leukemia or lymphoma in remission
- **Healthcare workers** and **childcare staff**
- Women of **childbearing age** planning pregnancy
- **Post-exposure contacts** of confirmed cases, especially in healthcare or institutional settings
- **Adolescents and adults** without a history of infection or vaccination

Key Takeaways

- **Selective varicella vaccination** targeting high-risk contacts is scientifically and ethically justifiable when resources are limited or disease burden is moderate.
- It's **clinically effective**, cost-efficient, and helps protect those most vulnerable.
- Risks around shingles and uncertain long-term immunity make universal vaccination less appealing in certain settings.
- Physician recommendation and improved public education on varicella complications are vital for uptake in selective schemes.

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