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Public Health Impact and Cost-Effectiveness of Recombinant Zoster Vaccine for Vaccinating Immunocompromised Adults Against Herpes Zoster in the United States

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Background

Herpes zoster (HZ, also known as shingles) is caused by reactivation of the varicella zoster virus and is characterized by a painful rash. It can lead to complications such as postherpetic neuralgia (PHN), a persistent pain that can last for months or years. While PHN is rare in individuals younger than 40 years, it affects up to 13% of individuals aged 60 years and older.[1]

Immunocompromised (IC) individuals are at increased risk of HZ, with greater disease burden, resource use, and costs than in immunocompetent individuals.[2,3] A study that found in a US adult community population, although 8% of HZ cases occurred among individuals who are IC, these individuals represented 23.8% of the total HZ-related costs.[2]

Recombinant zoster vaccine (RZV) is recommended in the United States (US) by the Advisory Committee on Immunization Practices (ACIP) for adults aged 19 years or older who are or will be at increased risk for HZ due to immunodeficiency or immunosuppression caused by known disease or therapy.[4]

Objective

To assess the **public health impact and cost-effectiveness of RZV versus no vaccination** against HZ for IC adults aged 18 years and older in the US

Methods

*Markov model simulating hypothetical cohorts of IC populations**

No HZ Vaccine or **RZV** vaccination of entire cohort at start of simulation

1-year cycle length | **30-year** time horizon | **3% per year** discounting of costs and quality-adjusted life years (QALYs)

The key outcome measure was the **incremental cost-effectiveness ratio (ICER)**, as measured by the incremental cost per QALY gained

Base case: hematopoietic stem-cell transplant (HSCT) recipients

Input	Value
Cohort size	19,671
Starting age	35 years
IC duration	5 years
HZ incidence	60/1,000 patient-years
Starting RZV efficacy	72.5%
RZV efficacy annual waning	9.1%

Scenario Analyses†

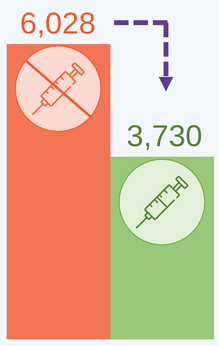
Scenario	Population (starting age in years)
Scenario A	22,106 renal transplant recipients‡ (40)
Scenario B§	279,100 patients with breast cancer‡ (45)
Scenario C**	8,480 patients with Hodgkin's lymphoma‡ (25)
Scenario D	1,018,846 patients with HIV†† (35)
Scenario E	60 HSCT recipient profiles varying by IC duration, HZ incidence, and starting age (25–45)

* Efficacy and waning inputs based on clinical trial data; epidemiological, cost, and utility inputs obtained from standard US sources and published literature.
† Starting age, cohort size, epidemiology, duration of IC status, and efficacy and waning of RZV varied in scenario analyses A–D.
‡ Based on the estimated incidence of the condition or procedure in the US.
§ As an example of patients with solid tumors.
** As an example of patients with hematological malignancies.
†† Based on the estimated prevalence of the condition in the US.

Results: Base Case

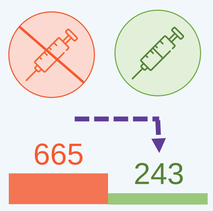
Health Outcomes: RZV versus No HZ Vaccine (n=19,671)

38% fewer HZ cases



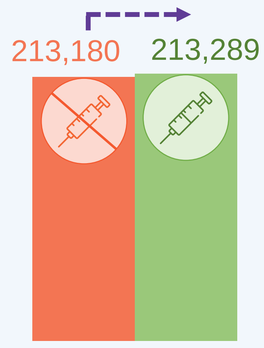
HZ cases

63% fewer PHN cases



PHN cases

109 QALYs gained



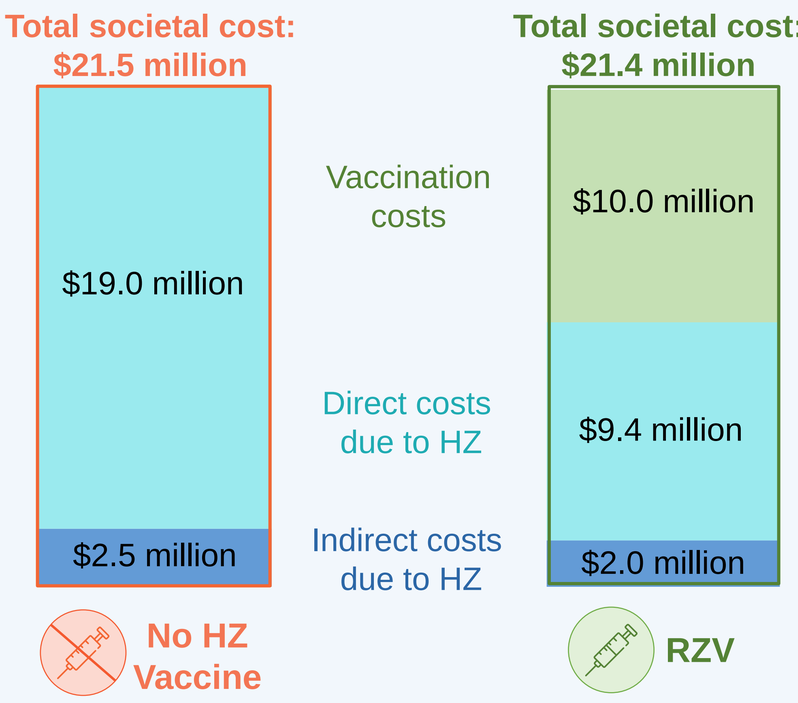
QALYs

The number needed to vaccinate (NNV) to avoid one HZ or PHN case was **9** or **47**, respectively.

Economic Outcomes and Cost-Effectiveness (n=19,671)

RZV was **cost-saving** (dominant strategy) versus No HZ Vaccine

✓ Total societal cost **$0.1 million lower** for RZV versus No HZ Vaccine



Results: Scenario Analyses

RZV was cost-saving for renal transplant recipients and cost-effective* for other IC populations

Scenario	NNV to avoid 1 HZ case	NNV to avoid 1 PHN case	ICER ($ per QALY gained)
Scenario A: Renal transplant recipients	5	37	Cost-saving
Scenario B: Patients with breast cancer	8	88	$67,682
Scenario C: Patients with Hodgkin's lymphoma	10	91	$95,972
Scenario D: Patients with HIV	9	68	$33,268

Scenario E: Of 60 input combinations:

86% of ICERS were <$100,000 per QALY gained

38% were **cost-saving** | 48% were **cost-effective*** | 8 scenarios resulted in ICERs >$100,000

ICERs were highest when:
- starting age was youngest (25 years),
- HZ incidence while IC was lowest (6/1,000 person-years), and
- IC status duration was briefest (1 year).

*Cost-effective at a willingness-to-pay threshold of $100,000 per QALY gained

Key Takeaways

1. Vaccinating US IC adults with RZV would reduce HZ cases and HZ-related complications, versus No HZ Vaccine.
2. Vaccination with RZV is expected to be cost-saving for HSCT recipients (base-case analysis) and renal transplant recipients, and cost-effective at a willingness-to-pay threshold of $100,000 per QALY gained for other modeled IC populations, versus No HZ Vaccine.

Plain Language Summary

Shingles (also known as herpes zoster) is more likely to occur and be severe in individuals with low immune function (immunocompromised).

A vaccine to protect against shingles is currently recommended in the United States for adults aged 19 years or older who are immunocompromised due to disease or treatment they are receiving for a disease.

Our analyses found that vaccination against shingles would reduce shingles cases and related complications in immunocompromised adults and investment prevention of shingles in these adults would likely provide good value.

Limitations

HSCT recipients were modeled in the base case because they have a high clinical need and the efficacy of RZV has been estimated in this population;[5,6] the scenario analyses modeled populations with relatively high disease burden.[3,7,8] However, the overall IC population is highly heterogeneous and thus the results from analysis of these subpopulations should be generalized to the wider IC population with caution.

Learn More

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References

1. CDC. Shingles (Herpes Zoster): Clincal Overview. 2020; 2. Yawn BP, Itzler RF, Wollan PC, et al. Health care utilization and cost burden of herpes zoster in a community population. Mayo Clinic Proc 2009;84:787-794; 3. McKay SL, Guo A, Pergam SA, et al. Herpes zoster risk in immunocompromised adults in the United States: a systematic review. Clin Infect Dis 2020;71:e125-e134; 4. Anderson TC, Masters NB, Guo A, et al. Use of Recombinant Zoster Vaccine in Immunocompromised Adults Aged ≥19 Years: Recommendations of the Advisory Committee on Immunization Practices - United States, 2022. MMWR Morb Mortal Wkly Rep 2022;71:80-84; 5. Dagnew AF, Ilhan O, Lee WS, et al. Immunogenicity and safety of the adjuvanted recombinant zoster vaccine in adults with haematological malignancies: a phase 3, randomised, clinical trial and post-hoc efficacy analysis. Lancet Infect Dis 2019;19:988-1000; 6. Bastidas A, de la Serna J, El Idrissi M, et al. Effect of Recombinant Zoster Vaccine on Incidence of Herpes Zoster After Autologous Stem Cell Transplantation: A Randomized Clinical Trial. JAMA 2019;322:123-133; 7. Chen SY, Suaya JA, Li Q, et al. Incidence of herpes zoster in patients with altered immune function. Infection 2014;42:325-334; 8. Habel LA, Ray GT, Silverberg MJ, et al. The epidemiology of herpes zoster in patients with newly diagnosed cancer. Cancer Epidemiol Biomarkers Prev 2013;22:82-90.

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Abbreviations: ACIP = Advisory Committee on Immunization Practices; HIV = human immunodeficiency virus; HSCT = hematopoietic stem-cell transplant; HZ = herpes zoster; IC = immunocompromised; ICER = incremental cost-effectiveness ratio; NNV = number needed to vaccinate; PHN = postherpetic neuralgia; QALY = quality-adjusted life year; RZV = recombinant zoster vaccine; US = United States.