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ASSESSMENT OF THE POTENTIAL HERPES ZOSTER AND POSTHERPETIC NEURALGIA CASE AVOIDANCE WITH VACCINATION IN THE UNITED STATES

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BACKGROUND

- Herpes zoster (HZ), commonly referred to as shingles, is a viral infection caused by the reactivation of latent varicella-zoster virus [1].
- The risk of HZ increases sharply with age. Without vaccination, 30% of individuals in the United States (US) will develop HZ during their lifetime (50% for people who live to age 85 years) [2].
- Postherpetic neuralgia (PHN), defined as pain that persists for 3 months after either rash onset or healing, is the most common complication of HZ [3-4]. Other less frequent complications of HZ include ocular, neurological and cutaneous complications [5].
- Costs related to HZ are substantial, leading to an annual bill to society estimated between $1.1 billion and $3.3 billion [6-8]. Projections suggest these costs are likely to increase, due to ageing of the population and increased severity of HZ with age [9].
- One vaccine is currently marketed in the US to prevent HZ, Zoster Vaccine Live (ZVL), and a HZ non-live subunit adjuvanted candidate vaccine (HZ/su) is under regulatory review.

OBJECTIVES

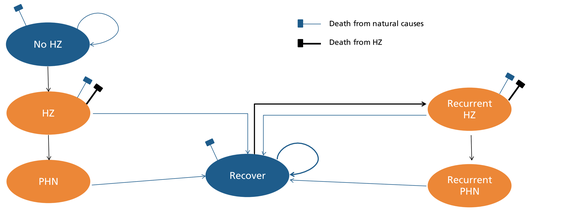
- The aim of this study was to compare the impact of HZ/su and ZVL vaccines on HZ and PHN case avoidance in two US cohorts:
  1) aged 60 years and older and
  2) aged 65 years and older.

METHODS

Mathematical model

- A multi-cohort Markov model called ZONA (ZOster ecoNomic Analyses), was developed. In ZONA, individuals in two age cohorts move between different health statuses **(Figure 1)**:

Figure 1: Model structure



HZ: herpes zoster; PHN: postherpetic neuralgia

1) ≥60 years of age (yoa) to represent the population for which the Advisory Committee on Immunization Practices currently recommends HZ vaccination.
2) ≥65 yoa to represent the portion of the population for which HZ is recommended that is on Medicare.
   - The model follows all individuals within each cohort using annual cycles over their remaining lifetimes from the year of vaccination.

Input source

Data for populating the ZONA model were taken from the published literature and national survey data sources.

- Per the Census Bureau [10], the US population included 66,830,729 adults aged ≥60 yoa and 47,760,852 aged ≥65 yoa in 2015.
- HZ incidence and the proportion of HZ individuals developing PHN were derived from published US-specific sources **(Table 1)**.

Table 1 : Key model inputs and sources for HZ and PHN epidemiology

Annual incidence of initial and recurrent HZ		Reference
60-69 yoa	0.00932	[16-17]
70-79 yoa	0.01202	
≥80 yoa	0.01278	
Percentage of initial and recurrent HZ cases with PHN (%)		
60-69 yoa	6.20%	[12,17-19]
70-79 yoa	12.70%	
≥80 yoa	12.70%	

HZ: herpes zoster; PHN: postherpetic neuralgia; yoa: years of age
Note: Recurrent rates of HZ are assumed based on Yawn et al. (2011) [17].

- Efficacy and waning parameters were derived from clinical trials for both vaccines **(Table 2)**. The vaccine efficacy (VE) of ZVL against HZ and PHN was from the Shingles Prevention Study [11]. The VE of HZ/su against HZ and PHN was taken from the ZOE-50 and ZOE-70 studies [12-13].

Table 2 : Key model inputs and sources for efficacy, waning and 2nd dose compliance

Initial vaccine efficacy against HZ (%)		Reference
HZ/su (two doses)		
60-69 yoa	98.40%	[12-13]
70-79 yoa	97.84%	
≥80 yoa	97.84%	
HZ/su (one dose)		
60-69 yoa	90.00%	[18-19]
70-79 yoa	69.50%	
≥80 yoa	69.50%	
ZVL		
60-69 yoa	63.89%	[11]
70-79 yoa	40.85%	
≥80 yoa	18.25%	
Annual waning of efficacy (%)		
HZ/su (two doses)		
Up to 70 yoa and years 1-4	1.00%	[12-13]
Up to 70 yoa and years ≥5	2.30%	
≥70 yoa	3.60%	
HZ/su (one dose)		
Years 1-4	5.40%	Assumed
Years ≥5	5.10%	
ZVL		
Years 1-4	5.40%	[20]
Years ≥5	5.10%	
Second-dose compliance for HZ/su		
(sensitivity range, lower and higher bounds %)	69% (45-89%)	[15,18-19]

HZ: herpes zoster; HZ/su: Herpes Zoster non-live subunit adjuvanted candidate vaccine; yoa: years of age; ZVL: Zoster Vaccine Live

- Baseline vaccine coverage for both vaccines was assumed to be 30.6% and 34.2% in the ≥60 yoa and ≥65 yoa cohorts, respectively [14].
- We assumed that the HZ/su doses were given two months apart. Compliance of the second dose of HZ/su was assumed to be 69% in the base case based on the vaccination series completion and compliance rates of hepatitis A and B among US adults [15].

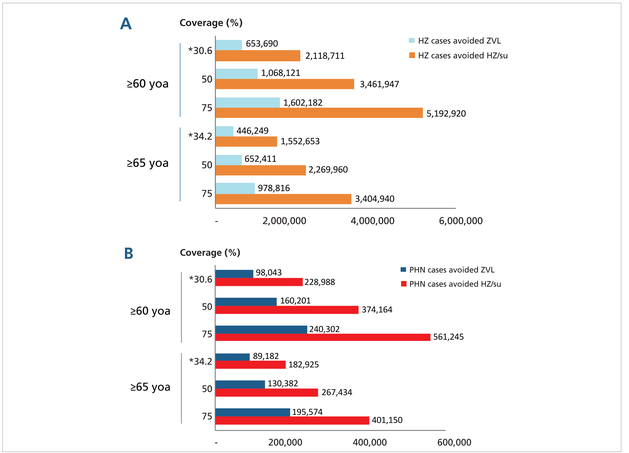
Sensitivity Analyses

- We varied HZ/su and ZVL coverage and then HZ/su second-dose compliance and observed the effects on HZ and PHN case avoidance from HZ vaccination. These inputs were chosen for sensitivity analyses because they were potential targets of public health interventions and modifiable by health care providers, policy makers and advocates.

RESULTS

- The ZONA model estimated that, compared to no vaccination against HZ, vaccinating with HZ/su would prevent 2,118,711 and 1,552,653 HZ cases in the ≥60 yoa and ≥65 yoa age cohorts, respectively, compared to 653,690 and 446,249 using ZVL **(Figure 2A)**.
- HZ/su would reduce the number of PHN cases by 228,988 and 182,925 in the two age cohorts, respectively, compared to 98,043 and 89,182 using ZVL **(Figure 2B)**.
- Reduction of HZ and PHN cases using HZ/su with baseline coverage allows the same avoidance as ZVL with a 2-fold higher vaccine coverage (75%) in both cohorts **(Figures 2A and 2B)**.

Figure 2: HZ(A) and PHN(B) case avoidance under varied assumptions about HZ vaccine



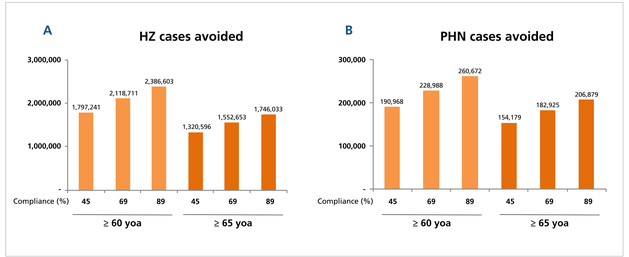
*HZ: herpes zoster; PHN: postherpetic neuralgia; yoa: years of age; HZ/su: Herpes Zoster non-live subunit adjuvanted candidate vaccine; ZVL: Zoster Vaccine Live; * Base-case assumptions*

CONCLUSIONS

- The candidate vaccine HZ/su demonstrated greater reduction of HZ and PHN cases in the US when compared to the currently available ZVL, due to higher and sustained vaccine efficacy.
- Sensitivity analyses varying second-dose compliance for HZ/su demonstrated case avoidance greater than ZVL at all values considered, even at the lower bound of 45% compliance.
- Increasing vaccination rates and compliance rates result in substantial HZ and PHN case avoidance. Public health strategies to increase rates should be considered.

- HZ/su second-dose compliance variation from lower to upper bounds (45-89%) was also tested to validate robustness of HZ and PHN case avoidance. These outcomes were found to be sensitive to compliance. However, at the lower bounds of compliance for HZ/su (45%), HZ and PHN case avoidance still remained higher than ZVL **(Figure 3)**.

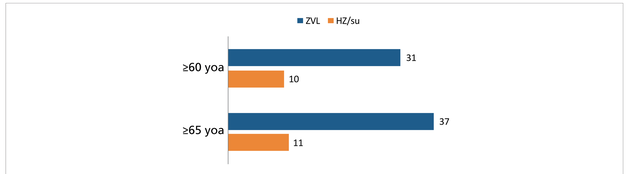
Figure 3: HZ(A) and PHN(B) case avoidance under varied assumptions about HZ/su second-dose compliance in ≥60 and ≥65 years of age cohorts



HZ: herpes zoster; HZ/su: Herpes Zoster non-live subunit adjuvanted candidate vaccine, PHN: postherpetic neuralgia; yoa: years of age

- Case avoidance outcomes indicate that the number needed to vaccinate in order to prevent one HZ case is 3- and 4-fold lower for HZ/su than for ZVL in ≥60 yoa and ≥65 yoa cohorts, respectively **(Figure 4)**.

Figure 4: Number needed to vaccinate in order to prevent one HZ case using HZ/su or ZVL in ≥60 and ≥65 years of age cohorts



HZ: herpes zoster; HZ/su: Herpes Zoster non-live subunit adjuvanted candidate vaccine; ZVL: Zoster Vaccine Live; yoa: years of age

REFERENCES: [1] Oxman MN. J Am Osteopath Assoc. 2009;109(6 Suppl 2):S13-7. [2] Centers for Disease Control and Prevention (CDC). Shingles (herpes zoster): overview. 2016. available at http://www.cdc.gov/shingles/about/overview.html. [Accessed August 19, 2017]. [3] Centers for Disease Control and Prevention (CDC) MMWR. Recommendations of the Advisory Committee on Immunization Practices (ACIP) 2008; available at https://www.cdc.gov/mmwr/preview/mmwrhtml/rr5705a1.htm [Accessed May 31th, 2017]. [4] Kawai K et al. Vaccine. 2014;32(15):1645-53. [5] Yawn BP et al. Mayo Clin Proc. 2007;82(11):1341-9. [6] Yawn BP et al. Mayo Clin Proc. 2009;84(9):787-94. [7] McLaughlin JM et al. J Prim Prev. 2015;36(4):259-73. [8] Curran D et al, submitted to Vaccine. [9] Varghese L et al. BMC Geriatr. 2017;17(1):30. [10] United States Census Bureau. Annual estimates of the resident population by single year of age and sex for the United States: April 1, 2010 to July 1, 2015. American Fact Finder. 2015; available at https://www.census.gov/data/datasets/2016/demo/popest/nation-detail.html [accessed 1 July 2017]. [11] Merck. Zostavax prescribing information. February 2016. Available at: http://www.merck.com/product/usa/pi_circulars/z/zostavax/zostavax_pi2.pdf. [Accessed March 7, 2017]. [12] Cunningham et al. N Engl J. Med.2016;375(11):1019-32. [13] Lal H et al. N Engl J Med. 2015;372(22):2087-96. [14] Centers for Disease Control and Prevention (CDC) Vaccination Coverage Among Adults in the United States, National Health Interview Survey, 2015; available at https://www.cdc.gov/vaccines/imz-managers/coverage/adultvaxview/coverage-estimates/2015.html [Accessed September 8, 2017]. [15] Patterson BJ et al. A claims-based analysis of hepatitis a, b, and a/b vaccination series completion and compliance among us adults. ISPOR 22nd Annual International Meeting. Boston, MA, USA; 2017. [16] Johnson BH et al. BMC Infect Dis. 2015 Nov 6;15(1):502. [17] Yawn BP et al. Mayo Clin Proc. 2011 Feb 28;86(2):88-93. [18] GSK. Efficacy, safety and immunogenicity study of GSK Biologicals' Herpes Zoster vaccine GSK1437173A in adults aged ≥70 years (ZOSTER-022 study). 2016. Available at: https://www.gsk-clinicalstudyregister.com/files2/113077-Clinical-Study-Result-Summary.pdf. [Accessed 13 Sep 2017]. [19] GSK. Efficacy, safety, and immunogenicity study of GlaxoSmithKline (GSK) Biologicals' Herpes Zoster (HZ) vaccine GSK1437173A in adults aged ≥ 50 years (ZOSTER-006 study). 2015. Available at: https://www.gsk-clinicalstudyregister.com/files2/110390%20-%20Clinical-Study-Result-Summary.pdf. [20] Morrison VA et al. Clin Infect Dis. 2015 Mar 15;60(6):900-9.

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