Human and Economic Burden of Adult Vaccine-preventable Disease (VPD)

Connecticut, 2010

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A little about me…

Current and Past Roles

- **2010-2012** Epidemiologist on Field-based HEOR team, Pfizer Specialty MDG
- **2006-2010** Cancer Epidemiologist & Biostatistician The Ohio State University Comprehensive Cancer Center
- **2005-2006** QA Chemist, Cargill, Inc.

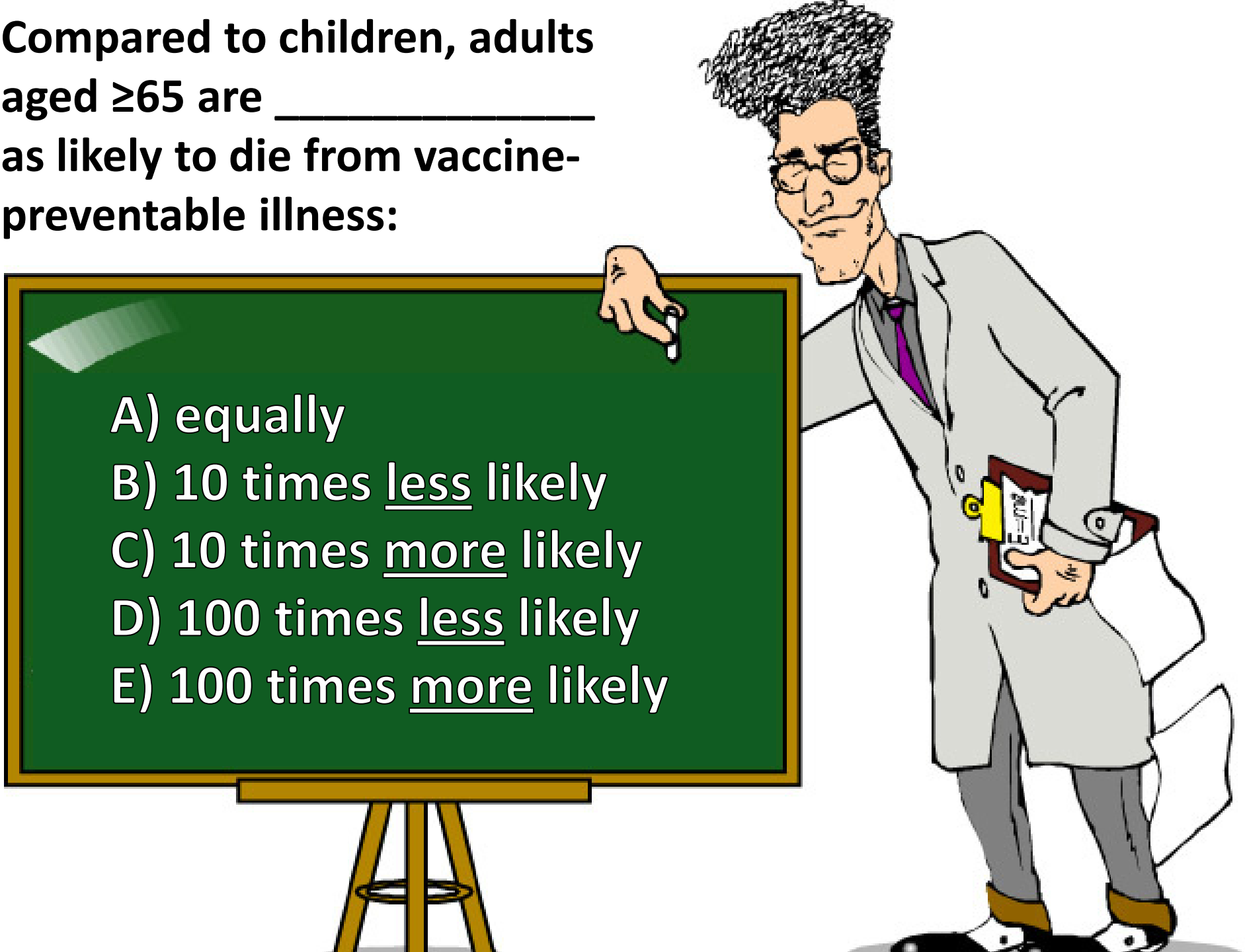
Education

- **PhD, MSPH** Public Health - Epidemiology The Ohio State University College of Public Health
- **BA** Zoology Miami University (Oxford, OH)

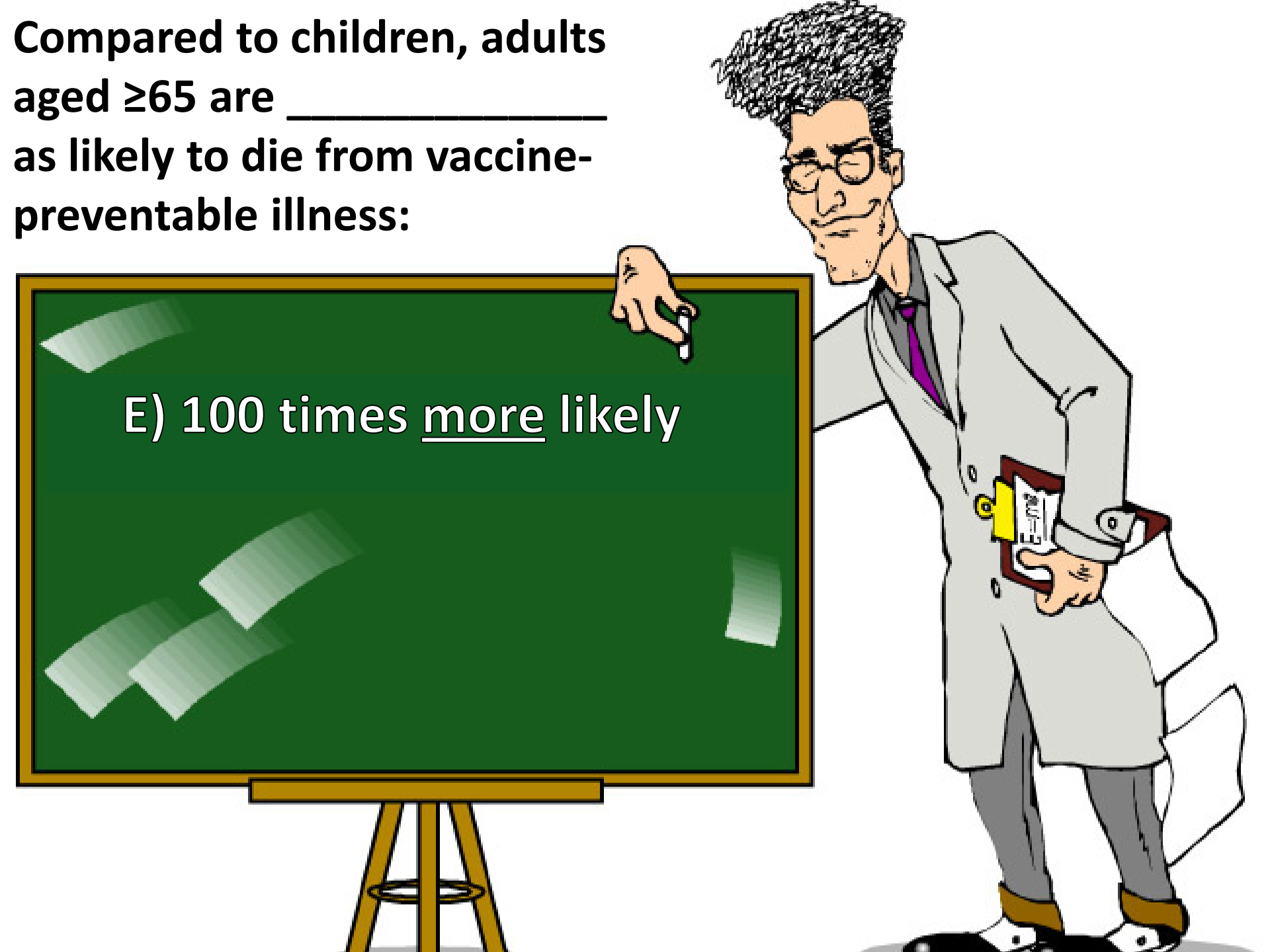
Acknowledgements

- **Litjen “LJ” Tan, MD**
  - Director, Medicine and Public Health, AMA
  - Chief Strategy Officer, Immunization Action Coalition
- **Joseph Fortuna, MD**
  - Vice-Chair, Michigan Primary Care Consortium
- **Annette Mercatante, MD, MPH**
  - Medical Health Officer, St Clair County Health Dept
- **Verna Welch, PhD, MPH**
  - Sr. Director / Team Leader IORS, Pfizer Specialty Care

Compared to children, adults aged ≥65 are _____ as likely to die from vaccine-preventable illness:



Compared to children, adults aged ≥65 are _____ as likely to die from vaccine-preventable illness:



- Primary focus on pediatric immunization
- Limitations in state-reportable data
  - Stringent case definition
  - Lack of requirements and incentives
- Silo effect in adult VPD research
- Lack of ownership for vaccinating adults
- Lack of cost data
- Disparate evidence for policy-makers

Research Questions

- **What is the human and economic burden of adult vaccine-preventable disease from a societal perspective?**
  - *The problem is not the problem. The problem is your attitude about the problem.* -Capt. Jack Sparrow
- **Can we answer this in straight-forward, population-based manner?**
  - *Don't let perfect be the enemy of good.* -Voltaire
- **Can we customize results?**
  - *Ever notice that anyone going slower than you is an idiot, but anyone going faster is a maniac?* -George Carlin

Adult VPD Model: the four diseases

1) Influenza

2) Pneumococcal

- Invasive Disease (bacteremia & meningitis)
- Non-bacteremic Pneumococcal Pneumonia (NPP)

3) Herpes Zoster

4) Pertussis

Adult VPD Model: the four inputs

1) Population Data

- 2010 US Census Data
- American Fact-Finder Website

2) Est. Incidence Rates (per 100,000)*

- Conservative estimates from large population-based studies

3) Est. Direct Costs (per case)*

- Preventive, diagnostic, and treatment services related to a particular condition from the peer-reviewed literature

4) Est. Indirect Costs (per case)*

- Value of income lost from decreased productivity, restricted activity, absenteeism, and bed days
- Does NOT include mortality costs or leisure time costs

***all estimates derived from the peer-reviewed literature and age-adjusted where possible**

Adult VPD Model: two subpopulations

1) 'All On-Label'

- Age group for each adult VPD where there is at least one FDA-approved and marketed vaccine indicated for prevention of the disease
- **≥18** for influenza and pertussis
- **≥50** for pneumococcal disease and herpes zoster

2) 'All Aged ≥50'

VPD Model Backbone

- **$N \times IR \times (Cost_{dir} + Cost_{ind}) \approx Cost_{total}$**
  - For each disease
  - Age-adjust to population where possible
  - All costs adjusted to 2010 US Dollars using CPI

- **Where:**
  - **N** = **the # of persons**
  - **IR** = **est. incidence rate**
  - **$Cost_{dir}$** = **est. direct cost per case**
  - **$Cost_{ind}$** = **est. indirect cost per case**
  - **$Cost_{total}$** = **est. total population cost**

If you hate mathematical formulas…

+

=

Base-Case Assumptions

Influenza, Pertussis, and Herpes Zoster, Connecticut 2010

Disease & Age Group	# Persons* (in 1,000s)	Incidence Rate (per 100,000)	Est. Direct Costs (per case)	Est. Indirect Costs (per case)
Influenza[a,b]				
18 or older	2,757	6,310	$140	$377
Pertussis[h,i]				
18 or older	2,757	196	$395	$542
Herpes Zoster[f,g]				
50-59	524	460	$1,094	$2,636
60-69	352	690		
70-79	194	950		
80 or older	162	1,090		

*total aged ≥50 years is 2,907 (in 1,000s)

Base-Case Assumptions

Invasive Pneumococcal Disease, Connecticut 2010

Disease & Age Group	# Persons* (in 1,000s)	Incidence Rate (per 100,000)	Est. Direct Costs (per case)	Est. Indirect Costs (per case)
Bacteremia[c,d]				
50-64	728	20	$24,814	$1,923
65-74	255	37	$23,426	$597
75-84	167	50	$20,849	$143
85 or older	85	64	$17,259	$112
Meningitis[c,d]				
50-64	728	1	$30,518	$2,036
65-74	255	2	$32,256	$698
75-84	167	3	$28,584	$168
85 or older	85	4	$18,819	$117

*total aged ≥50 years is 2,907 (in 1,000s)

Base-Case Assumptions

Non-Bacteremic Pneumococcal Pneumonia (NPP), Connecticut 2010

Disease & Age Group	# Persons* (in 1,000s)	Incidence Rate (per 100,000)	Est. Direct Costs (per case)	Est. Indirect Costs (per case)
Inpatient NPP[c,d]				
50-64	728	57	$16,264	$1,493
65-74	255	193	$15,189	$485
75-84	167	566	$14,191	$123
85 or older	85	1,056	$12,917	$105
Outpatient NPP[c,d]				
50-64	728	186	$507	$710
65-74	255	370	$578	$225
75-84	167	620	$632	$56
85 or older	85	907	$695	$47

*total aged ≥50 years is 2,907 (in 1,000s)

Model Tenets: Providing Base-Case and *My*-Case Scenarios

Simplicity	• Backbone formula makes intuitive sense • Not too many bells and whistles
Transparency	• Model engine is visible and customizable • All base-case references are listed
Applicability	• Can be applied to different populations • Limitations highlighted / sensitivity

Let's Take a Look at the Model:

Excel-based, Customizable Interface

Model Output, Connecticut 2010
All on label

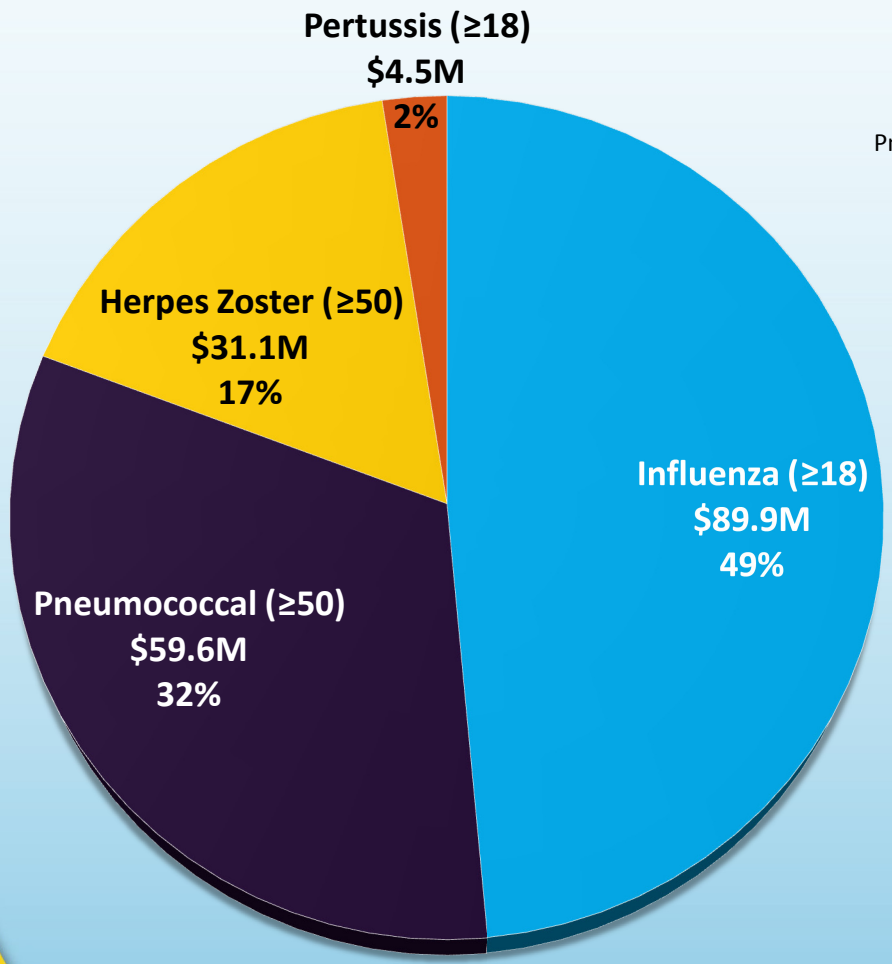
Disease & Age	# Cases	Dir Cost (per case)	Indir Cost (per case)	Total Cost (millions)	Dir Cost (millions)	Indir Cost (millions)
Influenza	173,972	140	377	89.9	24.4	65.6
Pneumococcal	7,246			59.6	54.4	5.2
Bacteremia	378	23,516	1,290	9.3	8.9	0.5
Meningitis	21	29,898	1,382	0.6	0.6	<0.1
NPP Inpt.	2,747	15,549	1,009	45.4	42.7	2.8
NPP Outpt.	4,101	551	478	4.2	2.3	2.0
Herpes Zoster	8,467	1,034	2,636	31.0	8.8	22.3
Pertussis	4,852	395	542	4.5	1.9	2.6
Total	**201,783**			**185.2**	**89.4**	**95.8**

Model Output, Connecticut 2010
≥50 years

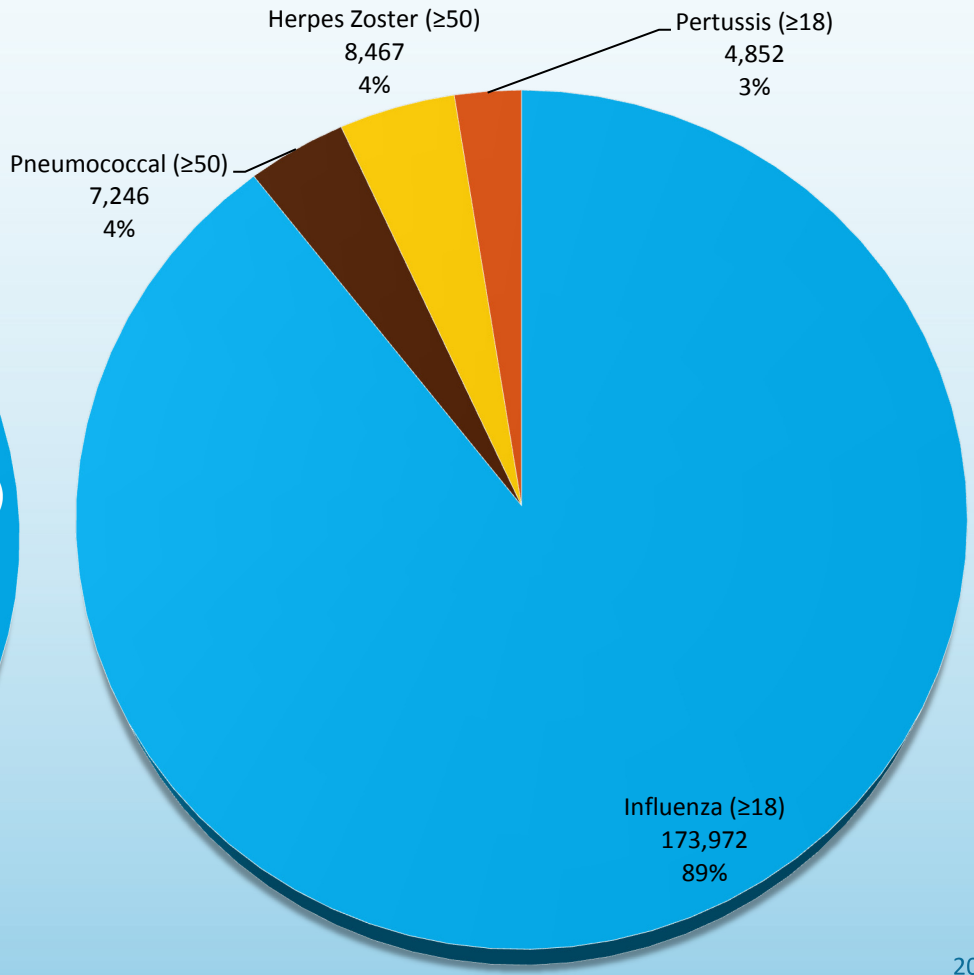
Disease & Age	# Cases	Dir Cost (per case)	Indir Cost (per case)	Total Cost (millions)	Dir Cost (millions)	Indir Cost (millions)
Influenza	77,887	140	377	40.3	10.9	29.4
Pneumococcal	7,246			59.6	54.4	5.2
Bacteremia	378	23,516	1,290	9.3	8.9	0.5
Meningitis	21	29,898	1,382	0.6	0.6	<0.1
NPP Inpt.	2,747	15,549	1,009	45.4	42.7	2.8
NPP Outpt.	4,101	551	478	4.2	2.3	2.0
Herpes Zoster	8,467	1,034	2,636	31.0	8.8	22.3
Pertussis	2,172	395	542	2.0	0.8	1.2
Total	**103,018**			**133.0**	**74.9**	**58.0**

All On-Label Burden of Adult VPD
Est. Total Cost CT, 2010: $185M

COST



INCIDENCE



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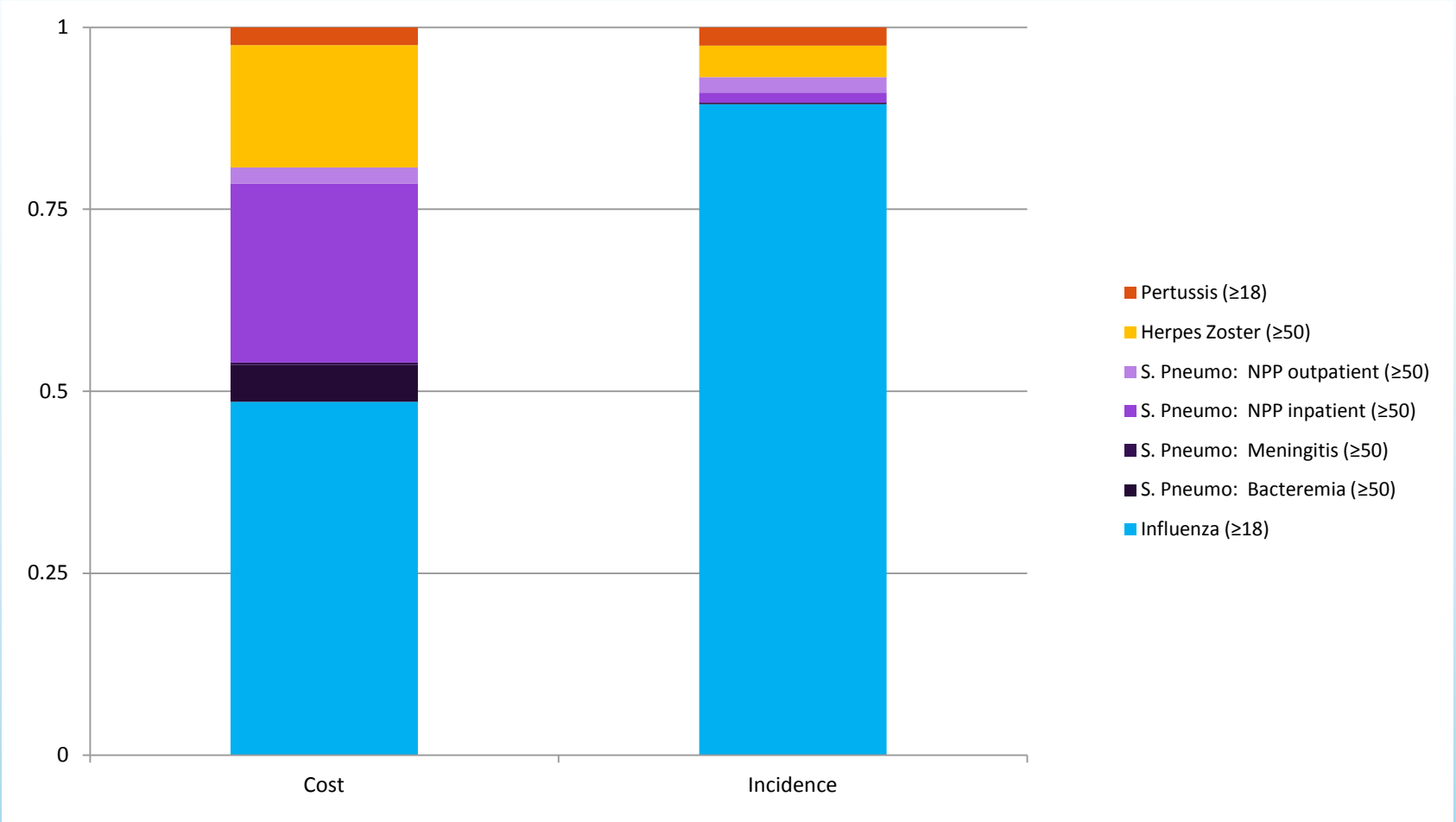
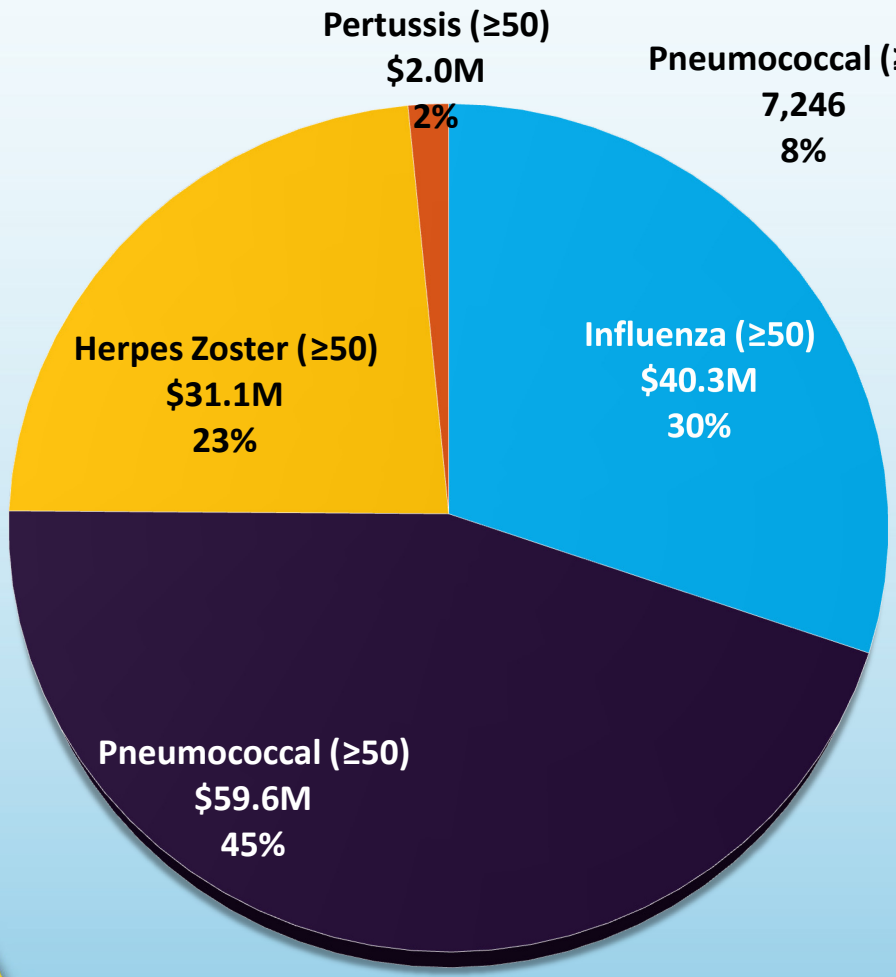


All ≥50 Burden of Adult VPD
Est. Total Cost CT, 2010: $133M

COST



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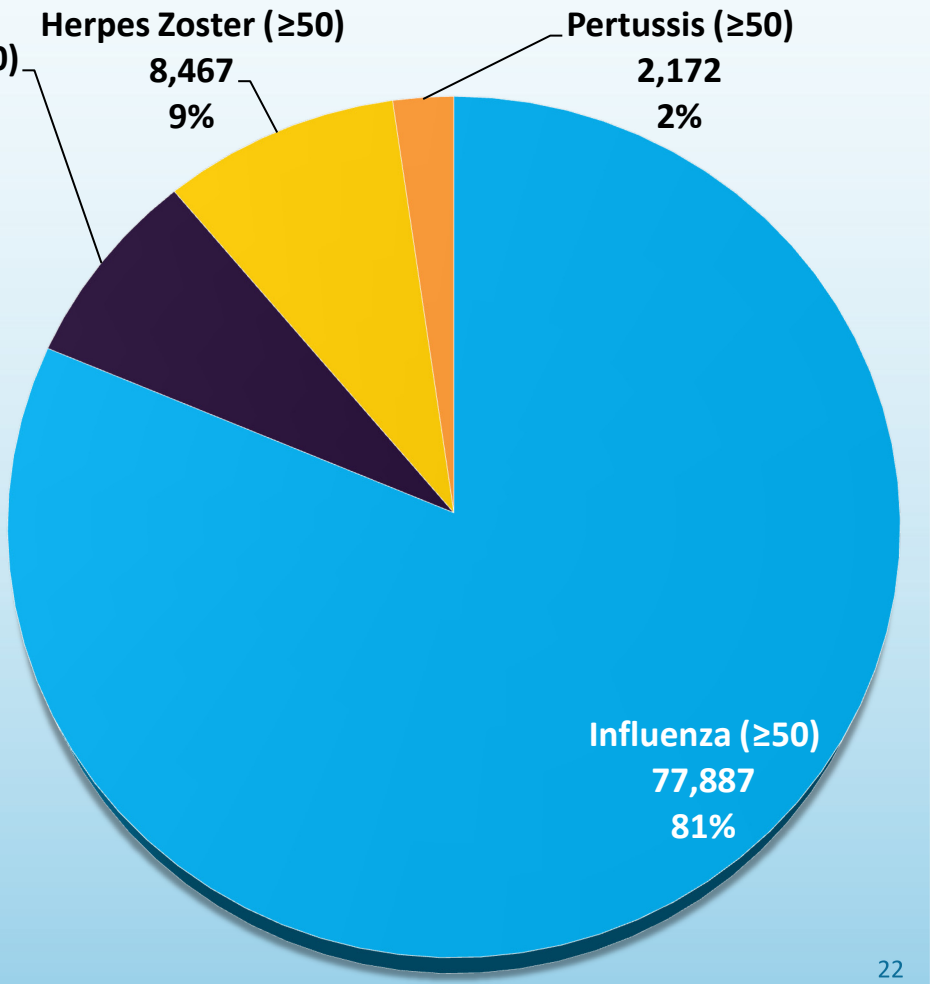
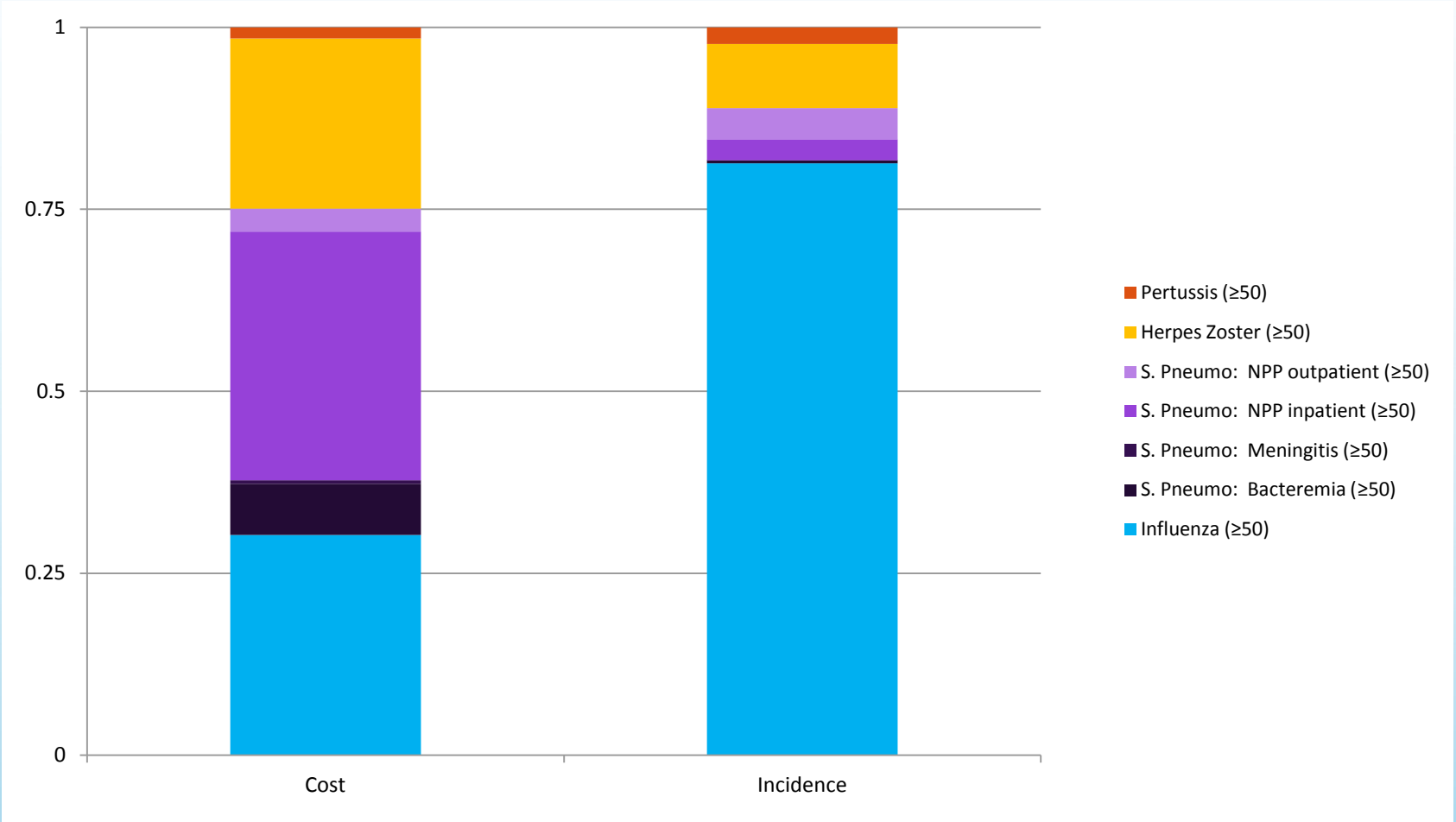
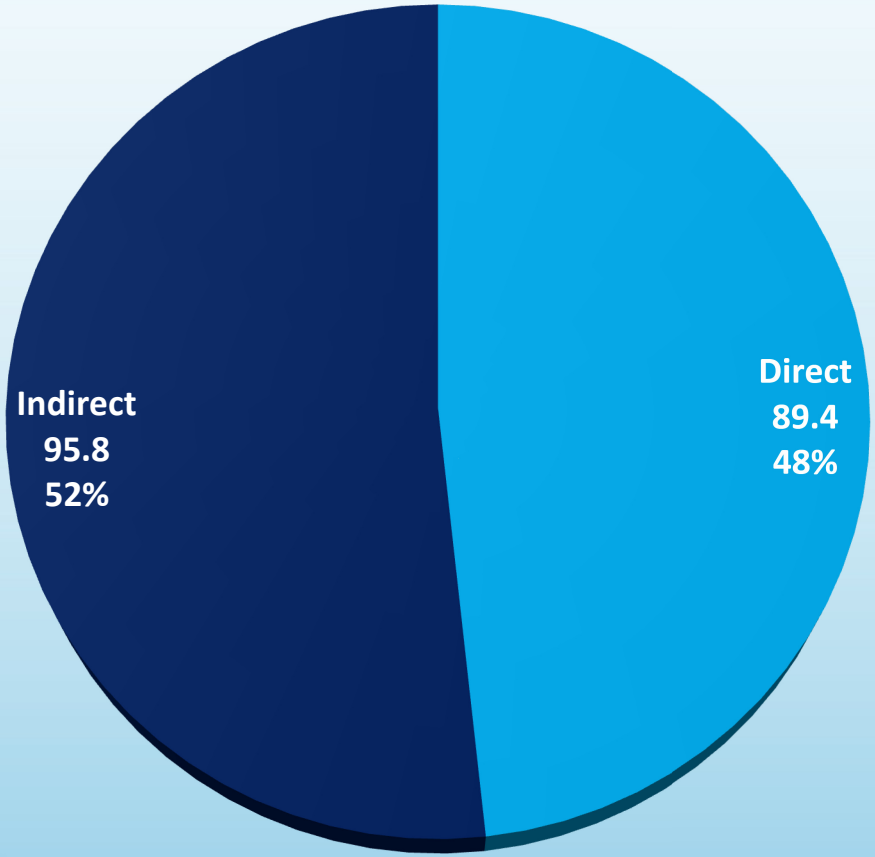


All ≥50 Burden of Adult VPD
Est. Total Cost CT, 2010: $133M

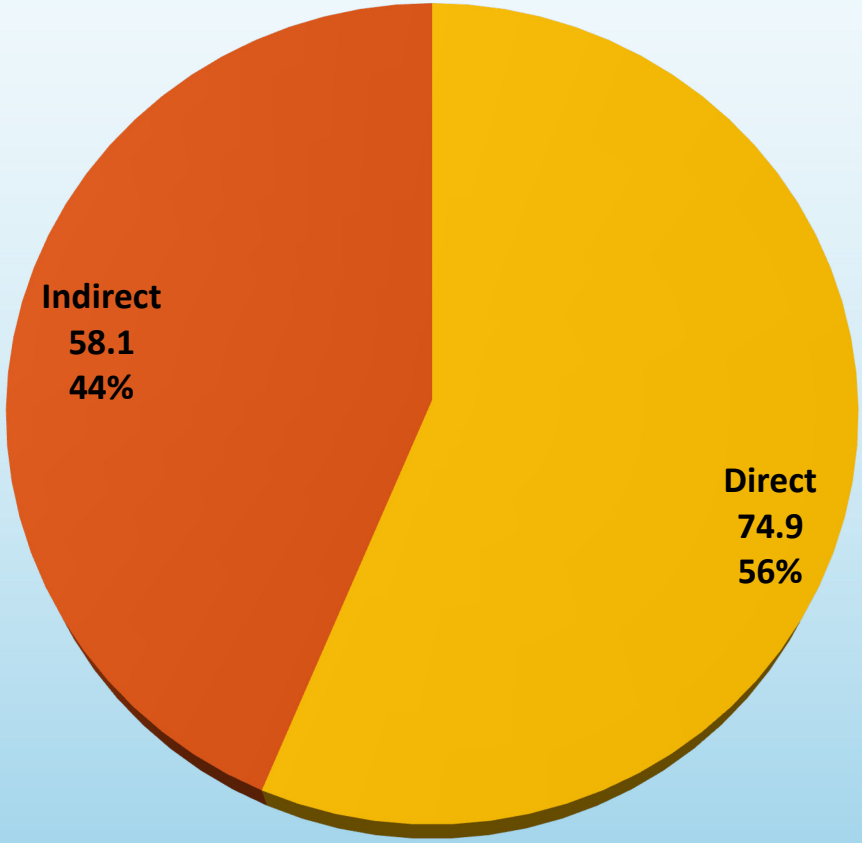


Proportion Direct/Indirect Costs Total Cost, Connecticut 2010

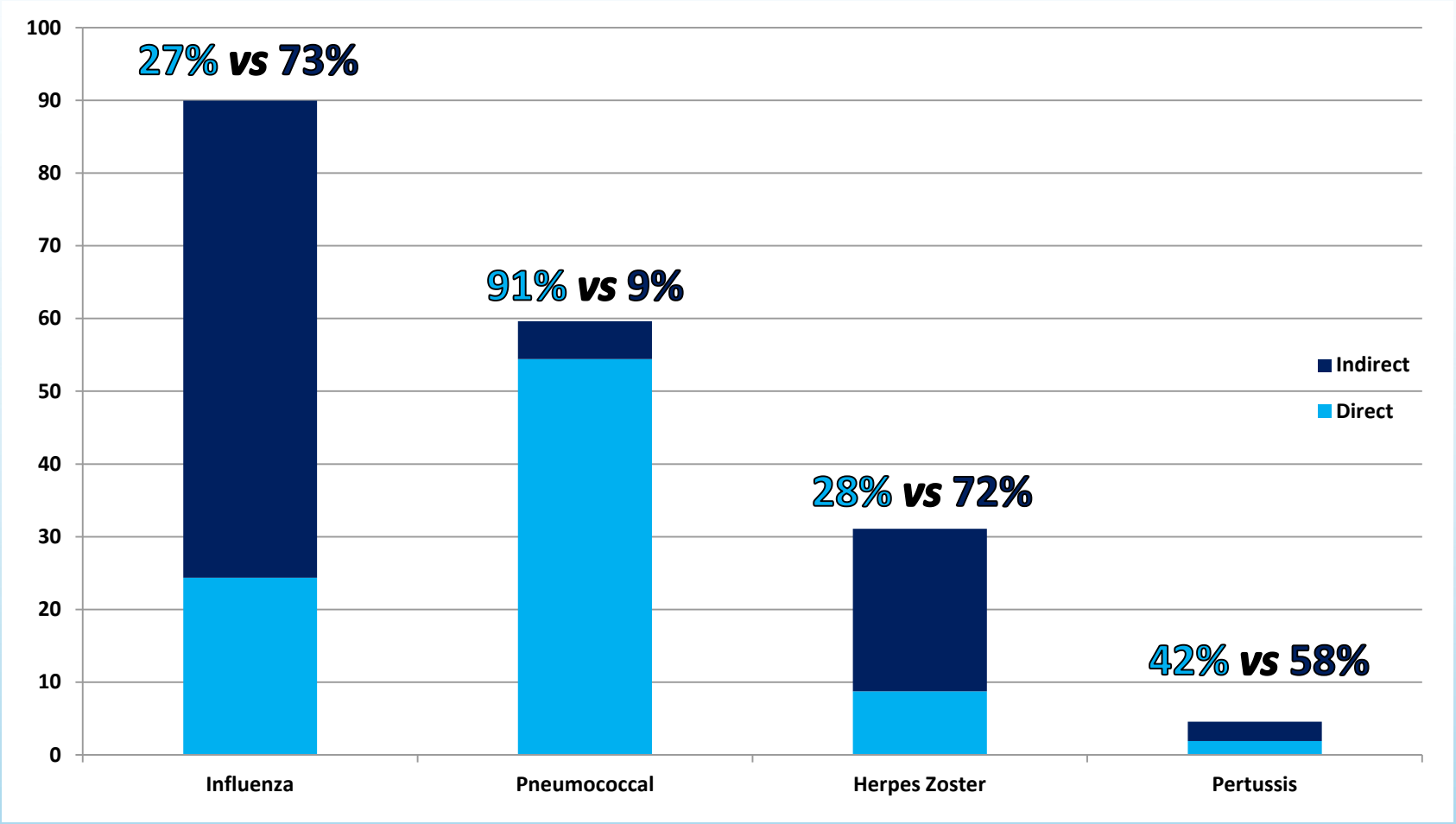
All On-Label



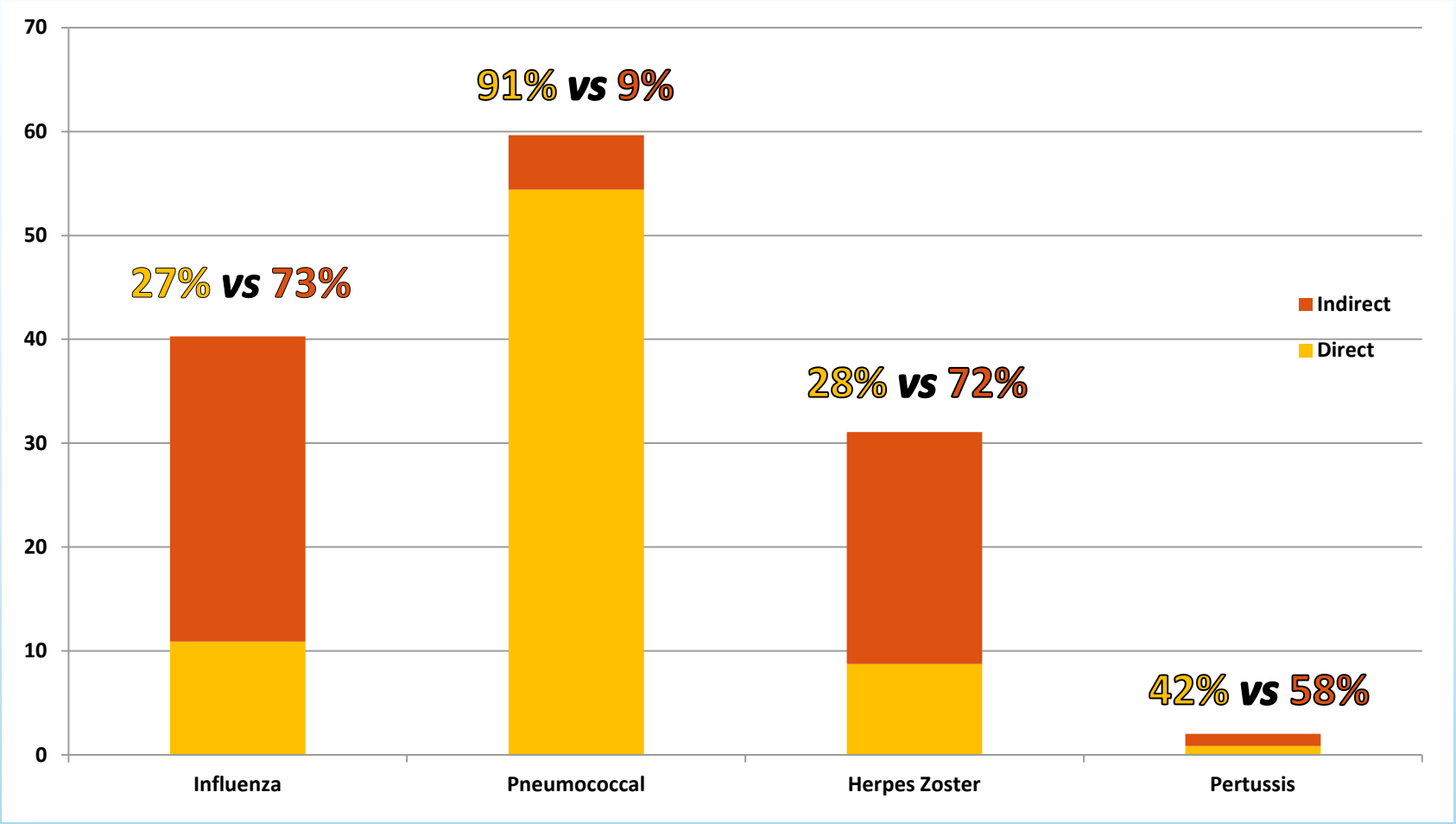
All ≥50 Years



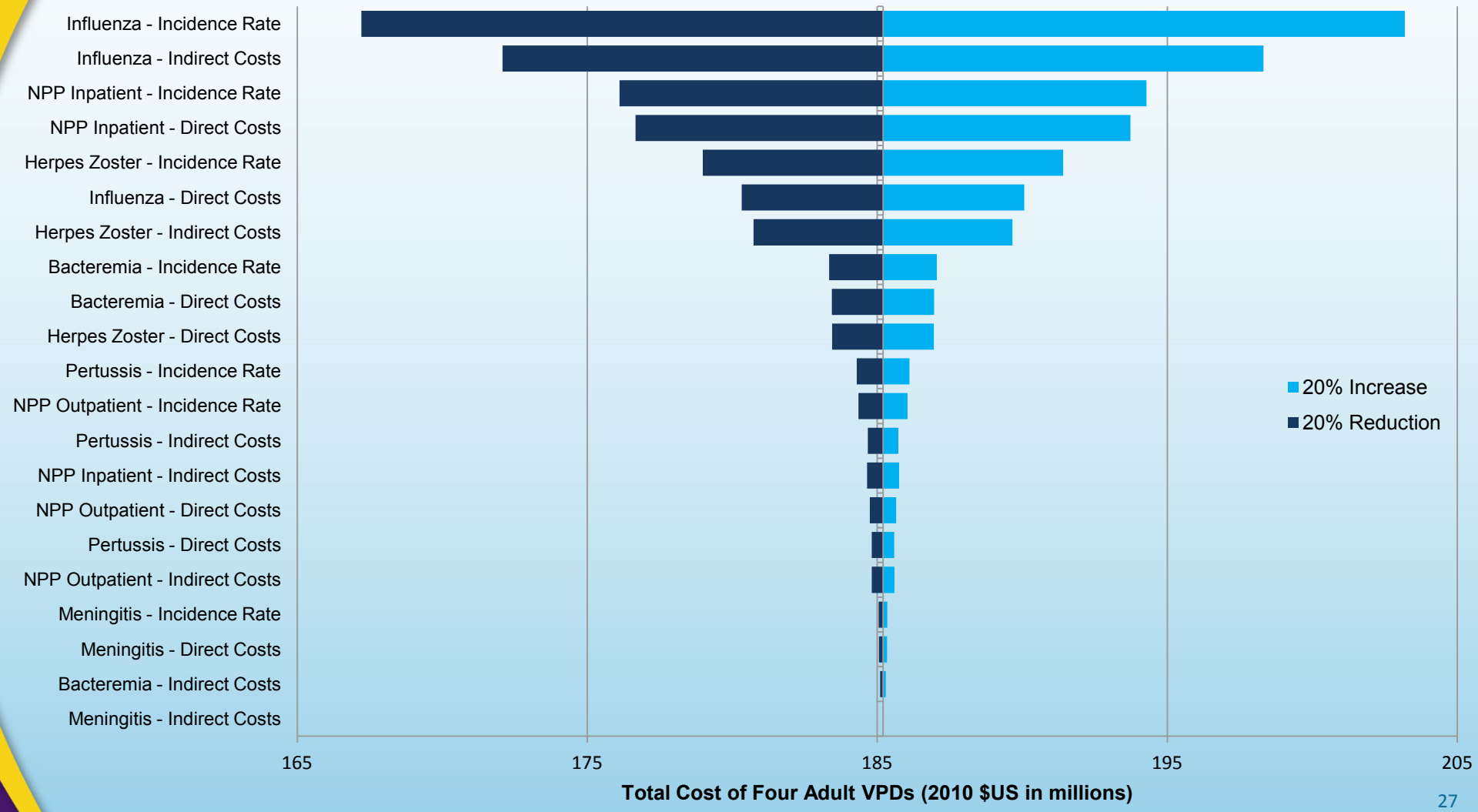
Proportion Direct/Indirect Costs: *All On-Label* Population



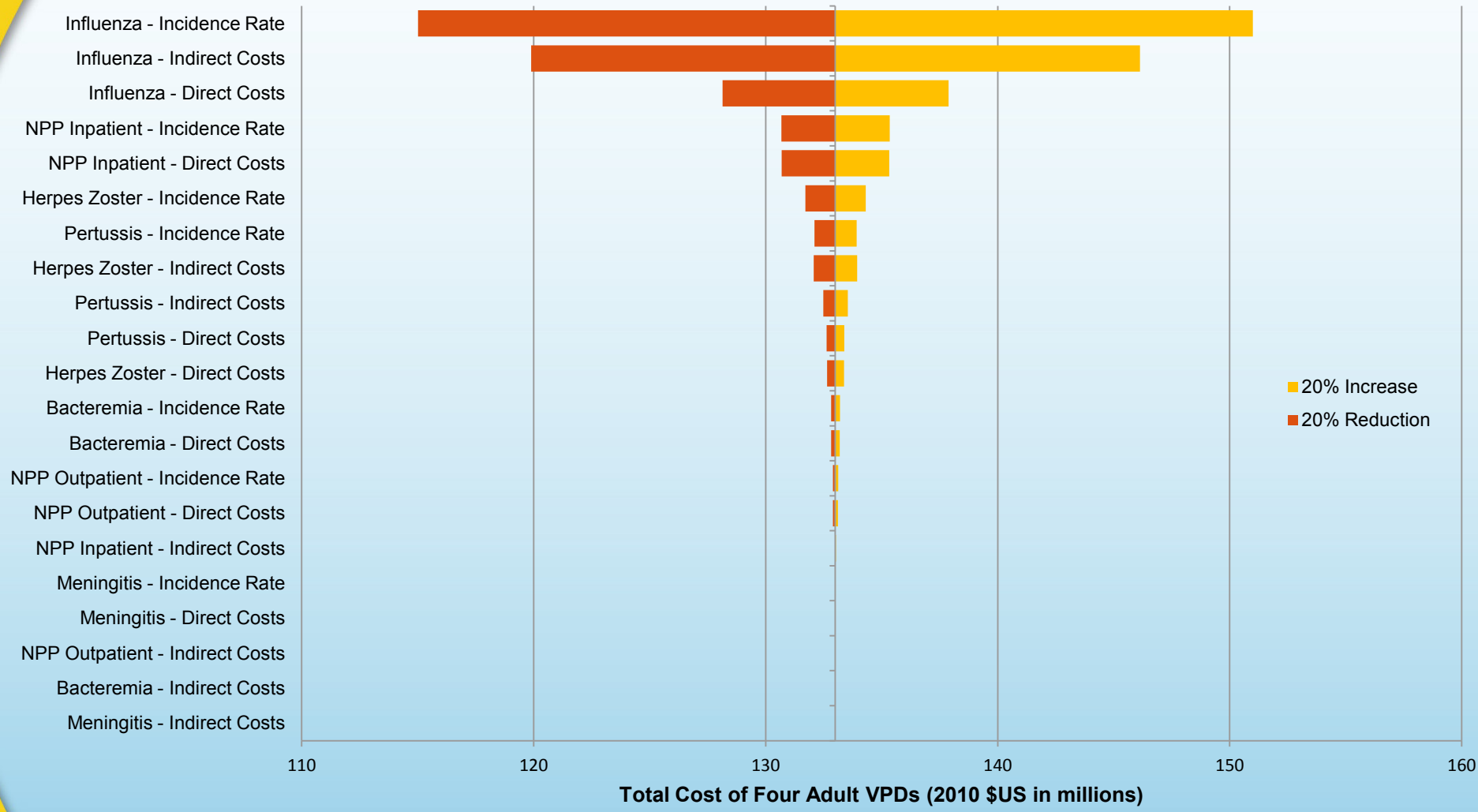
Proportion Direct/Indirect Costs: *All ≥50* Population



Sensitivity Analysis: *all on label*



Sensitivity Analysis: *all ≥50*



Limitations

All models are wrong… but some are useful.
(George Box, 1987)

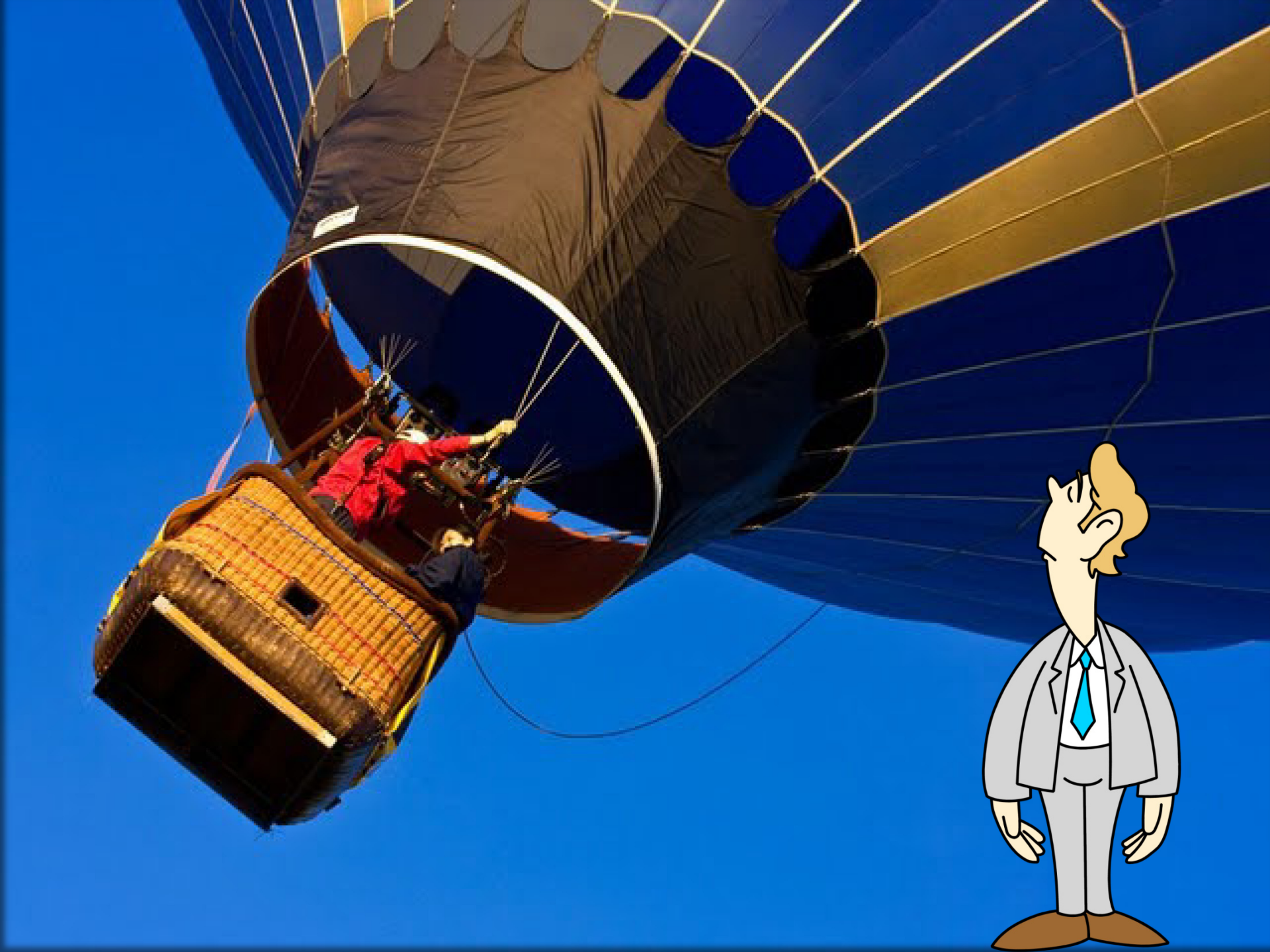
- The model reflects only the burden of disease attributable to the four adult VPDs included in the analysis. Because no vaccine is 100% effective, this model does not reflect the actual amount of disease that would necessarily be prevented with vaccination and should instead be interpreted as the burden of disease in 2010, human and economic, attributable to each disease included in the model.

- Although the model does age-adjust where possible for differences in state population demographics, it does not account for differences in other characteristics (e.g., race/ethnicity, health care access, population density, rural/urban mix) that may affect overall incidence rates or costs from state-to-state.

- In addition, though the model did include the four major adult VPDs, other adult VPDs (e.g., HPV and hepatitis) were not included and should be examined in the future.

Summary

- Estimated economic impact of 4 major adult VPDs was considerable ($185M *all on-label*, $133M aged ≥50).
- Among aged ≥50, pneumococcal disease made up 8% of cases, but 45% of costs—more than the estimated cost of influenza—with the large majority (85%) of pneumococcal burden due to NPP.
- Likewise, although herpes zoster only made up 9% of cases of adult VPD (among ≥50), it represented 23% of costs.
- Broadening adult immunization efforts beyond influenza only may help reduce the economic burden of disease.
- A pneumococcal vaccination effort, primarily focused on reducing the burden of NPP, may be a logical place to start (esp. if focus is on direct medical costs).



the road ahead…

- policy
- mindset and culture
- tools
- define and measure progress

References

[a]Number of cases based on 2010 U.S. Census estimates for persons over age 18 and assumes an influenza incidence rate of 63.1 per 1,000 person years for persons aged 18 or older based on the following report: *American Lung Association. Trends in Pneumonia and Influenza Morbidity and Mortality. American Lung Association Research and Program Services Epidemiology and Statistics Unit. April 2010.* Using data from: *Centers for Disease Control and Prevention. National Center for Health Statistics. National Health Interview Survey, 2008. Analysis by the American Lung Association, Research and Program Services Division using SPSS and SUDAAN software.*

[b]Adapted from Nichol KL. Cost-benefit analysis of a strategy to vaccinate healthy working adults against influenza. *Arch Intern Med*. Mar 12 2001;161(5):749-759. Average costs were estimated from a weighted average of age- and risk profile-specific direct and indirect costs and incidence. Leisure time and indirect costs from mortality were not included in indirect costs.

[c]The number of cases were based on estimates from the 2010 U.S. Census and pneumococcal pneumonia estimates from Weycker D, Strutton D, Edelsberg J, Sato R, Jackson LA. Clinical and economic burden of pneumococcal disease in older US adults. *Vaccine*. Jul 12 2010;28(31):4955-4960. Number of cases were estimated from a weighted average of age- and risk profile-specific incidence rates (see Table 1 in Weycker et al.). Leisure time and indirect costs from mortality were not included in indirect costs.

[d]Adapted from Weycker D, Strutton D, Edelsberg J, Sato R, Jackson LA. Clinical and economic burden of pneumococcal disease in older US adults. *Vaccine*. Jul 12 2010;28(31):4955-4960. Average costs were estimated from a weighted average of age- and risk profile-specific direct and indirect costs (see Table 1 in Weycker et al.). Leisure time and indirect costs from mortality were not included in indirect costs.

[e]Number of cases based on 2010 U.S. Census estimates for persons over age 50 and assumes a herpes zoster incidence rate of 4.6, 6.9, 9.5, and 10.9 per 1,000 person years for persons aged 50 to 59, 60-69, 70-79, and ≥80, respectively, based on Insinga RP, Itzler RF, Pellissier JM, Saddier P, Nikas AA. The incidence of herpes zoster in a United States administrative database. *J Gen Intern Med*. Aug 2005;20(8):748-753.

[f]Adapted from Pellissier JM, Brisson M, Levin MJ. Evaluation of the cost-effectiveness in the United States of a vaccine to prevent herpes zoster and postherpetic neuralgia in older adults. *Vaccine*. Nov 28 2007;25(49):8326-8337. Assumes 12-32% of Herpes Zoster patients develop PHN and that 4.3-5.7%, 3.2-5.9%, 1.1-2.9%, and 0.4-2.5% of patient develop ocular, neurological, cutaneous, or other complications, respectively. Average costs were estimated from a weighted average of age-specific costs and incidence. Leisure time and indirect costs from mortality were not included in indirect costs.

[g]Number of cases based on 2010 U.S. Census estimates for persons over age 18 and assumes a conservative pertussis incidence rate of 176 per 100,000 person years for persons aged ≥18 based on Nennig ME, Shinefield HR, Edwards KM, Black SB, Fireman BH. Prevalence and incidence of adult pertussis in an urban population. *JAMA*. Jun 5 1996;275(21):1672-1674.

[h]Adapted from Lee GM, Lett S, Schauer S, et al. Societal costs and morbidity of pertussis in adolescents and adults. *Clin Infect Dis.* 2004;39:1572-1580. Leisure time and indirect costs from mortality were not included in indirect costs.


QUESTIONS