Health Technology II
Measures against large-scale epidemics：

(3rd of 4 lectures)
Health disparity

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Goal of the class

To study the systematic methods to quantitatively evaluate the exacerbation of health disparities under a large scale epidemic.

Take home messages

- Systematic analyses of health disparity
  - 1/2/3 prevention
  - Donabedian's model for quality care
  - How to control "preference" in regression models?

- "Paradox in disparity"

  Disparity could be worsened by
  - Technological advancement
  - New information on disease/prevention/treatment
  - Insurance (and other?)

  → Because highest SES can gain the full benefits

  → How to mitigate/prevent the potential exacerbation of disparity?

Road Map

I) Definitions

II) How to systematically evaluate disparities?

III) “Preliminary” examples under the COVID-19

IV) Standardized method example in seasonal flu

V) Next Week

Definition by US CDC (2018) 1

Health disparities are

preventable differences in the burden of disease, injury, violence, or opportunities to achieve optimal health that are experienced by socially disadvantaged populations.

Definition by US CDC (2018) 2

Populations can be defined by factors

such as

race or ethnicity, gender, education or income, disability, geographic location (e.g., rural or urban), or sexual orientation.

Cf. Socio-economic status (SES) often includes education, income (& asset) etc. – social class (why not used in US?)

Definition by US CDC (2018) 3

Health disparities result from multiple factors, including

- Poverty
- Environmental threats
- Inadequate access to health care
- Individual and behavioral factors
- Educational inequalities

Road Map

I) Definitions

II) How to systematically evaluate disparities?

A) 3 types of preventions

Primary, Secondary, Tertiary

B) Donabedian's model for measuring quality

III) "Preliminary" examples under the COVID-19

IV) Standardized method example in seasonal flu

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Primary Prevention by WHO (2020)

Actions aimed at avoiding the manifestation of a disease (this may include actions to improve health through *changing the impact of social and economic determinants on health;*

the provision of information on behavioral and medical health risks, alongside consultation and measures to decrease them at the personal and community level; nutritional and food supplementation;

oral and dental hygiene education;

and *clinical preventive services such as immunization and vaccination of children, adults and the elderly, as well as vaccination or post-exposure prophylaxis for people exposed to a communicable disease).*

Secondary Prevention by WHO (2020)

Early detection

when this improves the chances for positive health outcomes

(this comprises activities

such as *evidence-based screening programs for early detection of diseases* or for prevention of congenital malformations;

and *preventive drug therapies* of proven effectiveness when administered *at an early stage of the disease*).

Tertiary Prevention by US CDC (2018)

Managing disease post diagnosis

to slow or stop disease progression

through measures

such as

chemotherapy, rehabilitation, and *screening for complications.*

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What are the criteria to compare in the health care fields?

How to compare/rank?

- Hospital A vs. Hospital B
- Health maintenance organization (HMO) A vs. HMO B
- Public health program in City A vs. City B

Which City performs better?

	Cost [$ per resident]
City A	Higher (than City B)
City B	Lower (than City A)

Which City performs better?

	Cost [$ per resident]	Quality
City A	Higher (than City B)	Same
City B	Lower (than City A)	Same

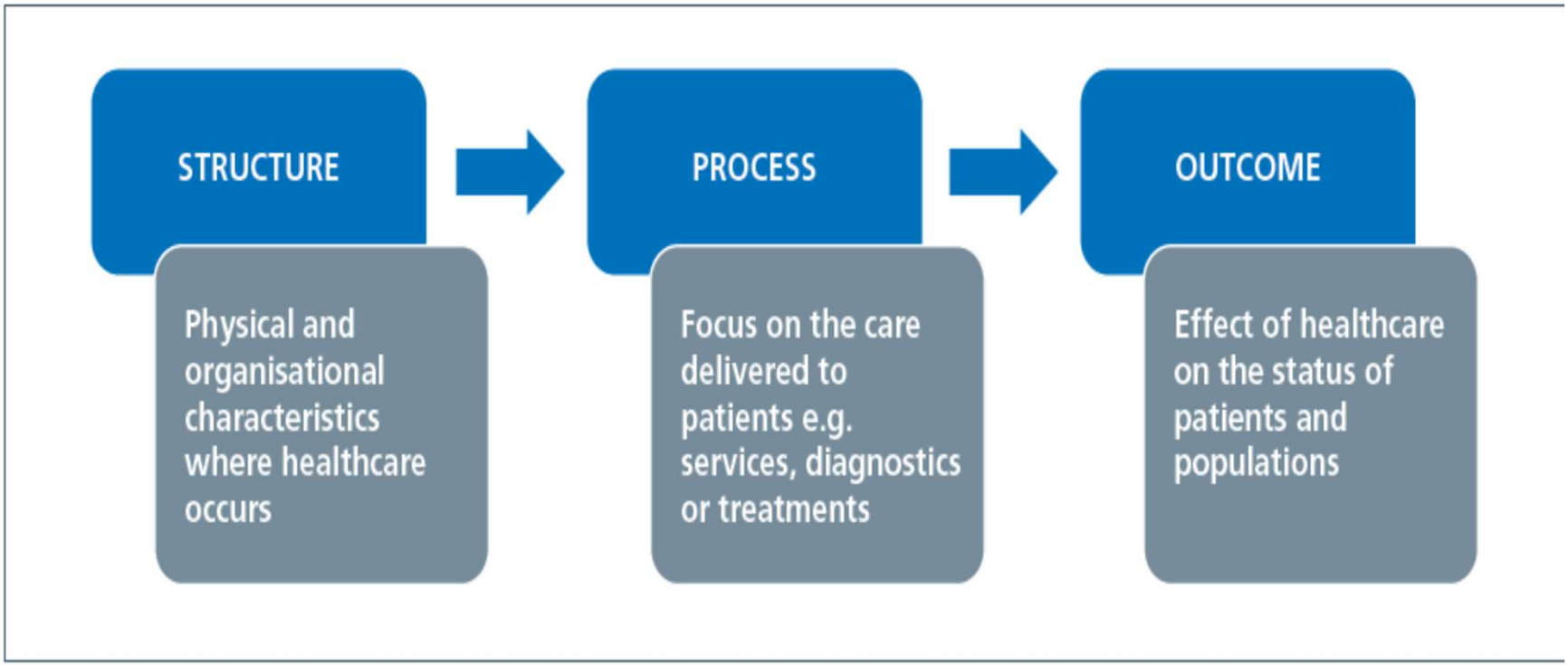
Which City performs better?

	Cost [$ per resident]	Quality
City A	Higher (than City B)	Lower
City B	Lower (than City A)	Higher

Donabedian's model for measuring quality care (Donabedian 2005)

Table source: UK NHS: https://improvement.nhs.uk/documents/2135/measuring-quality-care-model.pdf

Figure 1: The Donabedian model for quality of care



Donabedian's model for measuring quality care (Donabedian 2005): summary source: UK NHS: https://improvement.nhs.uk/documents/2135/measuring-quality-care-model.pdf

Structure measures: these reflect the attributes of the service/provider

- such as staff to patient ratios and operating times of the service.
- These are otherwise known as input measures.

- Other Examples: # of MDs, Hospital beds per population
- Easy to measure/improve (but roughest measure)

Donabedian's model for measuring quality care (Donabedian 2005): summary source: UK NHS: https://improvement.nhs.uk/documents/2135/measuring-quality-care-model.pdf

Process measures: these reflect the way your systems and processes work to deliver the desired outcome.

- For example, the length of time a patient waits for a senior clinical review, if a patient receives certain standards of care or not, if staff wash their hands, recording of incidents and acting on the findings and whether patients are kept informed of the delays when waiting for an appointment.

- Other Examples: Quantity of H care utilization, Timing (delayed or not) of H care utilization
- Relatively easy to measure (but not the final goal, except primary/secondary prevention)

Donabedian's model for measuring quality care (Donabedian 2005): summary source: UK NHS: https://improvement.nhs.uk/documents/2135/measuring-quality-care-model.pdf

Outcome measures: these reflect the impact on the patient and demonstrate the end result of your improvement work and whether it has ultimately achieved the aim(s) set.

- Examples of outcome measures are reduced mortality, reduced length of stay, reduced hospital acquired infections, adverse incidents or harm, reduced emergency admissions and improved patient experience.

- Best measures (among 3 model categories) but still needs careful risk-adjustment (i.e., controlling for baseline health status and other SES factors)

Extension of Donabedian's model for measuring quality care (Donabedian 2005): summary source: UK NHS: https://improvement.nhs.uk/documents/2135/measuring-quality-care-model.pdf

(4th category/dimension) Balancing measures:

these reflect unintended and/or wider consequences of the change that can be positive or negative.

- It is about recognizing these and attempting to measure them and/or reduce their impact if necessary.
- An example of a balancing measure would be monitoring emergency re-admission rates following initiatives to reduce length of stay

Which City performs better?

	Cost [$ per resident]	Quality
City A	Higher (than City B)	Higher
City B	Lower (than City A)	Lower

One approach: Cost-effectiveness analysis (to calculate “incremental cost effectiveness ratio”),

Which City performs better, when residents' health risks are accounted for?

	Cost [$ per resident]	Quality (mortality)	Average age of reidents
City A	Higher (than City B)	Same	60
City B	Lower (than City A)	Same	30

Reference: Risk Adjustment for Measuring Health Care Outcomes, Fourth Edition by Lisa Iezzoni

Publisher: Health Administration Press; None edition (August 1, 2012); ISBN-10: 1567934374; ISBN-13: 978-1567934373

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Question for All students
RE the following examples

Q1) Under Donabedian's model, which type of quality is measured?

- Structure, Process or Outcome

Q2) To prevent the observed disparity, what type of prevention is needed?

- Primary, Secondary or Tertiary

Q3) To improve the internal/external validity of a study, what will you recommend as a peer reviewer?

Disparity example 1 under COVID
Cited in Khunti et al, BMJ. 2020 Apr 20

"Concerns about a possible association between ethnicity and outcome were raised after

the first 10 doctors in the UK to die from covid-19 were identified as being from ethnic minorities."

Disparity example 2 under COVID
Cited in Khunti et al, BMJ. 2020 Apr 20

- "Of 2249 patients admitted to 201 critical care units in England, 64.8% were white, 13.8% were Asian, 13.6% were black, and 7.8% were from other or mixed ethnic groups."
- "The ethnic minority population of the UK was around 13% at the time of the last census in 2011."

Disparity example 3 under COVID
Cited in Khunti et al, BMJ. 2020 Apr 20

"An analysis by the *Washington Post* reports that counties with black majorities have three times the rate of covid-19 cases, and almost six times the rate of deaths, compared with counties where white residents are in the majority."

Disparity example 4 under COVID
Azar et al. Health Aff. 2020 May 21

- Analyzed 1,052 confirmed cases of COVID-19 from January 1–April 8, 2020 in Northern California, US
  - Enrolled in a large health care system (Sutter)

- Compared with non-Hispanic white patients, African Americans (AA) had 2.7 times the odds of hospitalization, after adjusting for age, sex, comorbidities, and income.
  - No difference in testing
  - *"Disparity may not be in who is tested, but when"*
  - Delayed care (more advanced stage at time of a test)
  - Because patients view delaying care as sensible option

  → Patients may lose $ or a job, if test (+)

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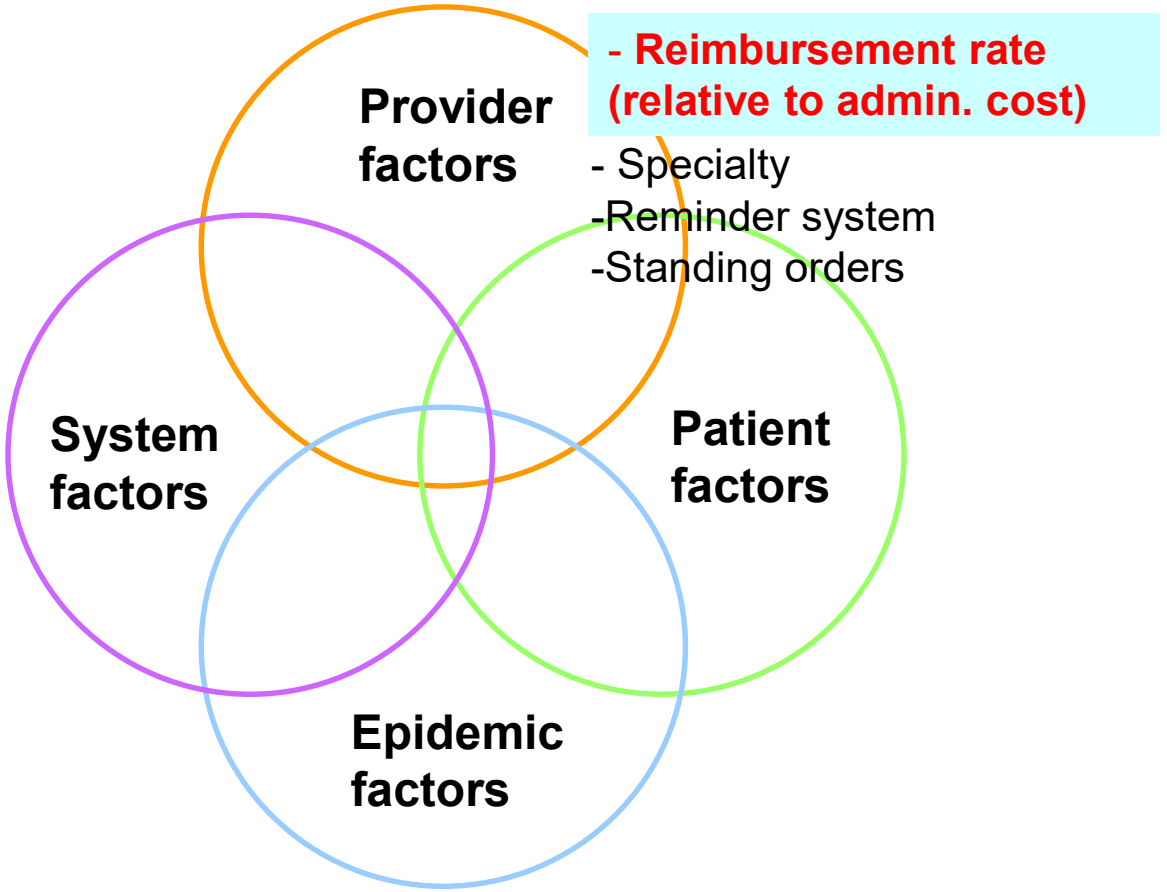
- Geographic disparity among children
- Race/ethnic disparity among adults (65+ y.o.)
  - – Vaccine supply shortage
  - – Media coverage on flu

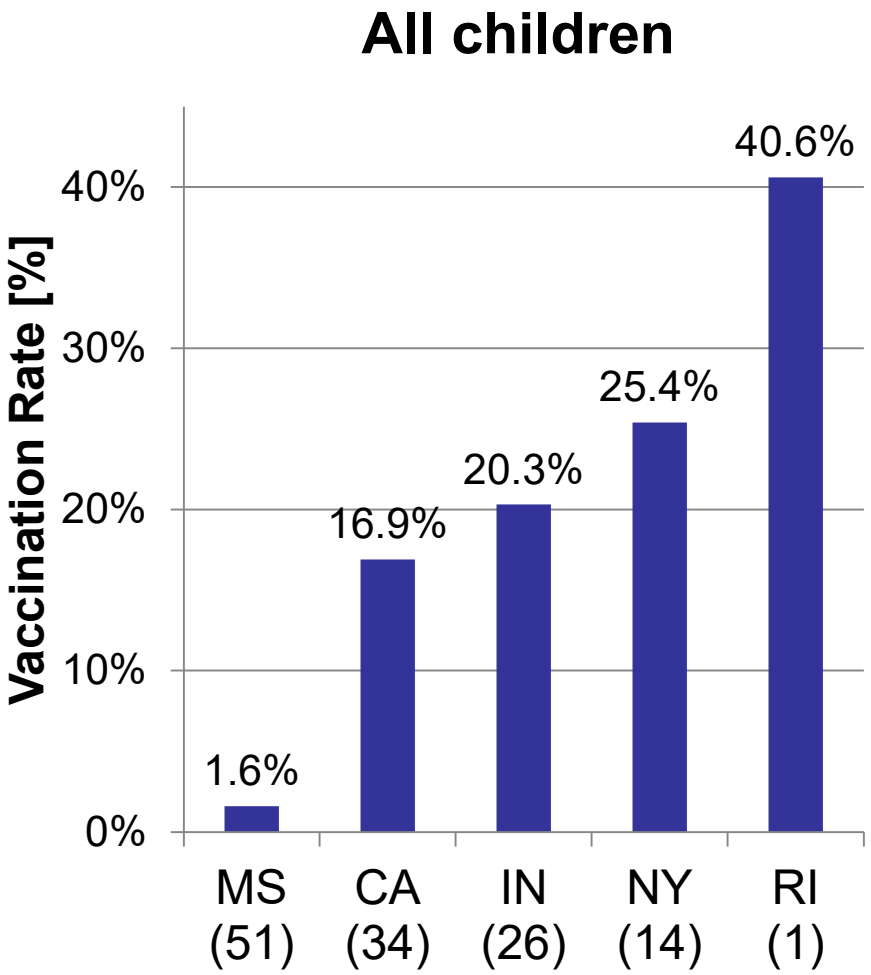
V) Next Week

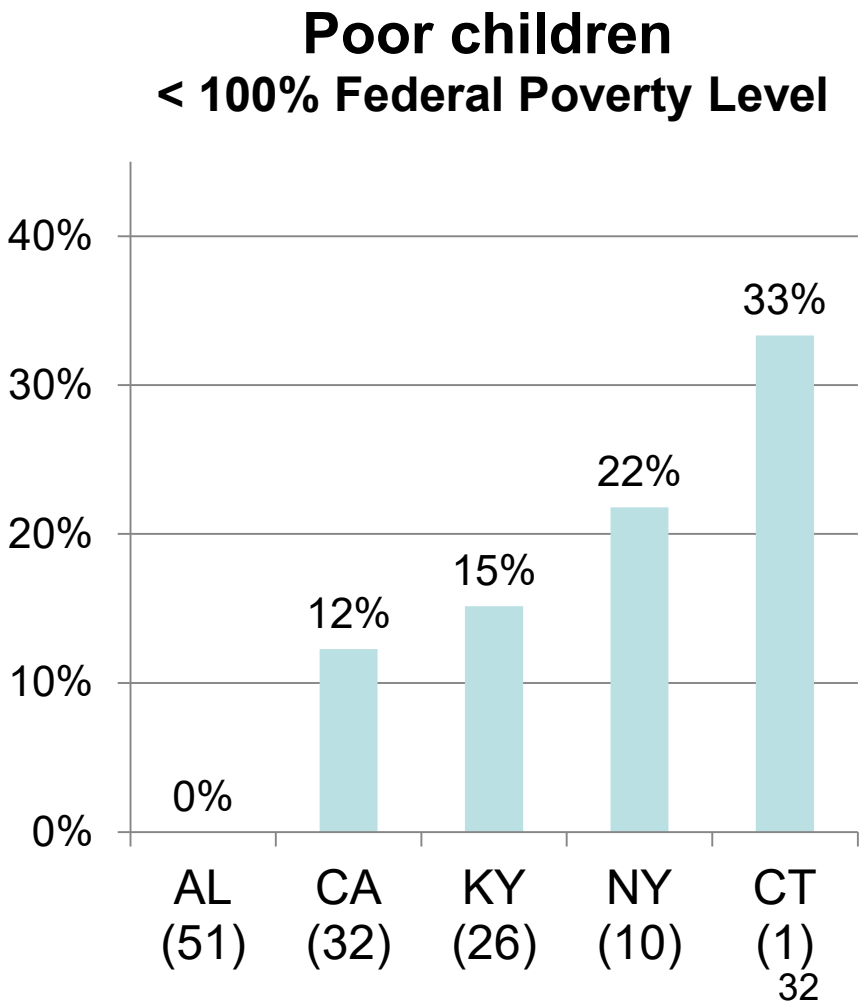
Conceptual Framework of Preventive Behavior: Case of Vaccination

(Task Force on Community Preventive Services, MMWR 1999)



Child Full Vaccination Rate (6-23mo)
2005-06 season (state ranking)





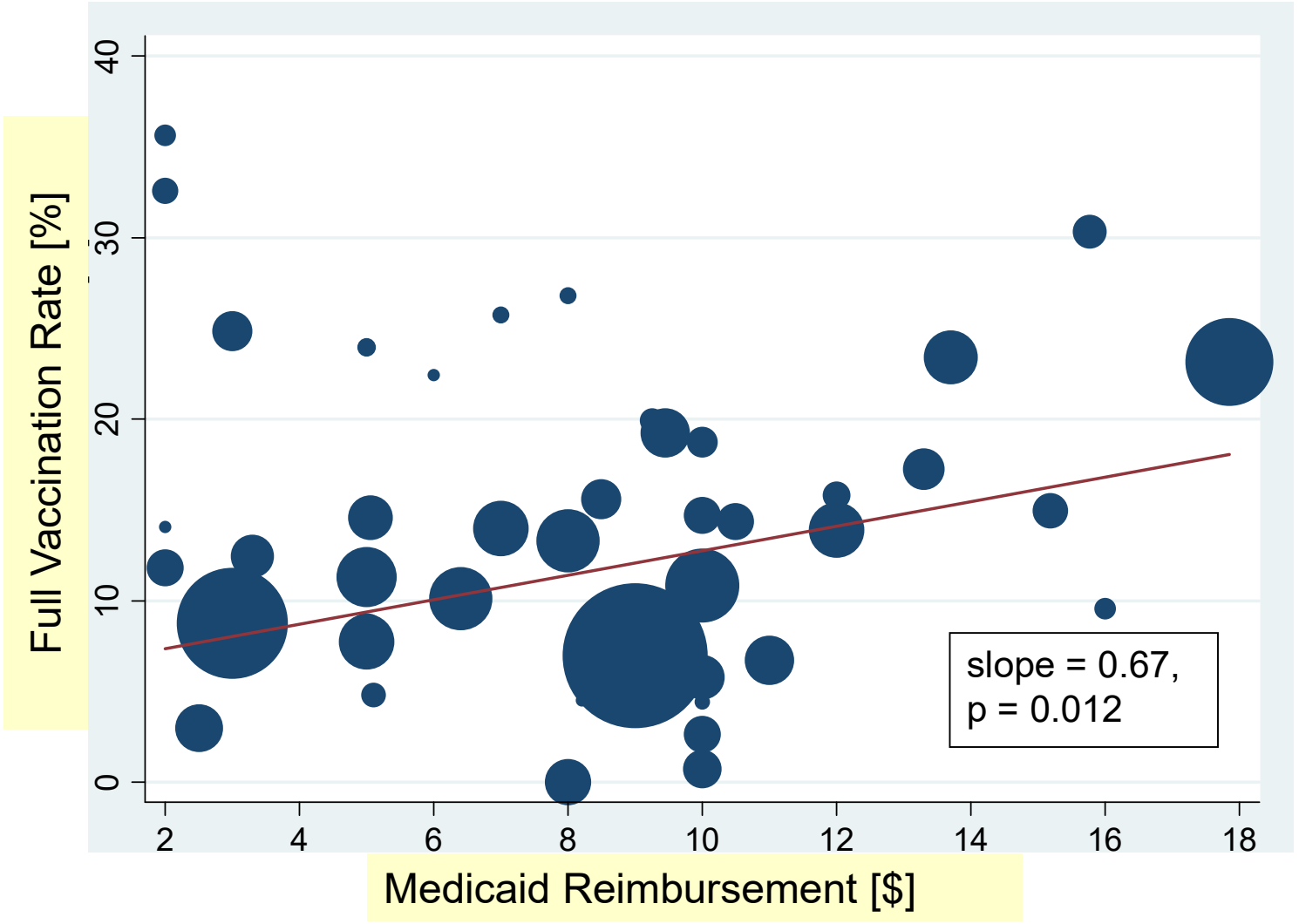
1) Medicaid reimbursement to administer vaccination

Background

- Medicaid reimbursement for administering vaccination
  - Min: $2.00 (NH etc); Max: $17.86 (NY) in 2005
  - Median: $8.40
- Provider cost: $20 to adm. one flu shot at pediatric clinic
  [2006 dollar value] (Yoo et al., *Pediatrics*, 2009)
  - *Physicians are losing money by giving flu shots*
  - Financial loss for VFC vaccination in all private pediatric practices [2006 dollars]
    2006-07 season
    - 20% vaccinated: Financial loss = $40 million
    - If 90% vaccinated: Financial loss = $208 million

    (Yoo et al. *Pediatrics* 2009)

State-level Reimbursement Rate and Full-Vaccination Rate among Poor Children§ in 48 States† (adj. with 15 factors) (Yoo et al., *Pediatrics 2010*)

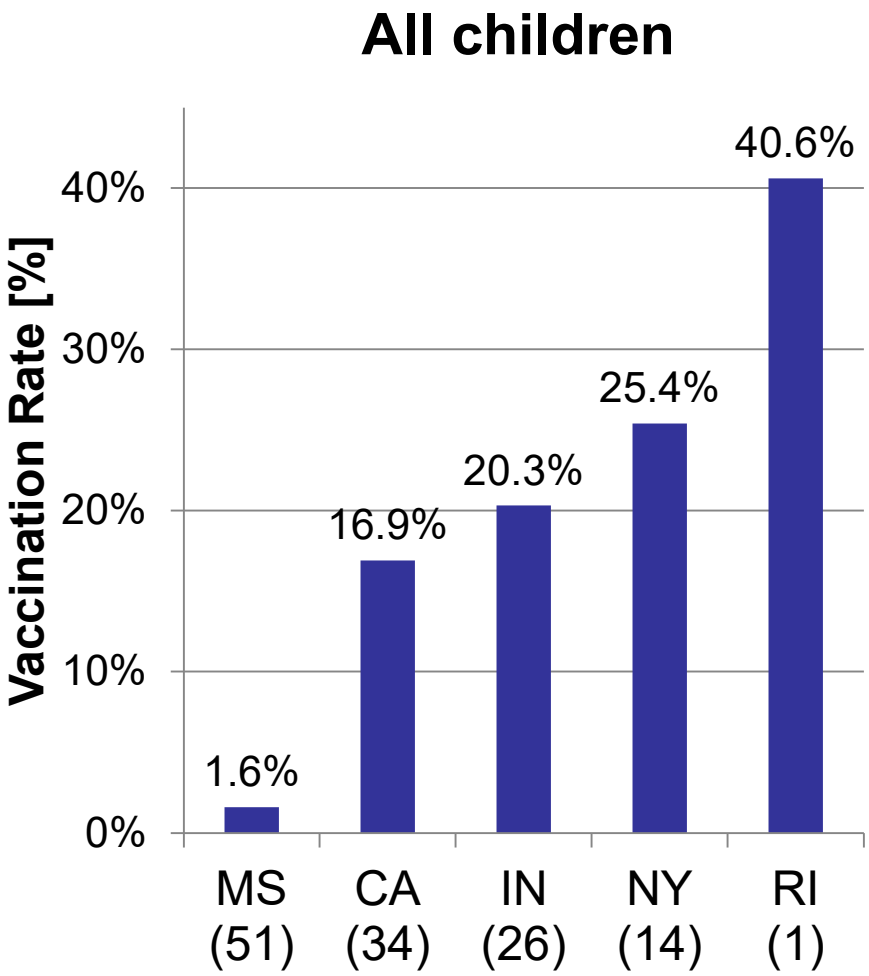


§ : Poor Children: Less than 100% Federal Poverty Level (FPL)

†: We excluded children in two states (Tennessee, Delaware) and D.C. due to lack of data.

Size of circles weighted with state poor child population size)

Child Full Vaccination Rate (6-23mo) 2005-06 season (state ranking)



- Geographic health disparity example
- After you control for individual factors (maternal education attainment) and aggregated factors (# of MDs per population), no difference in flu shot rate across states among all children/non-poor children.→ No disparity?

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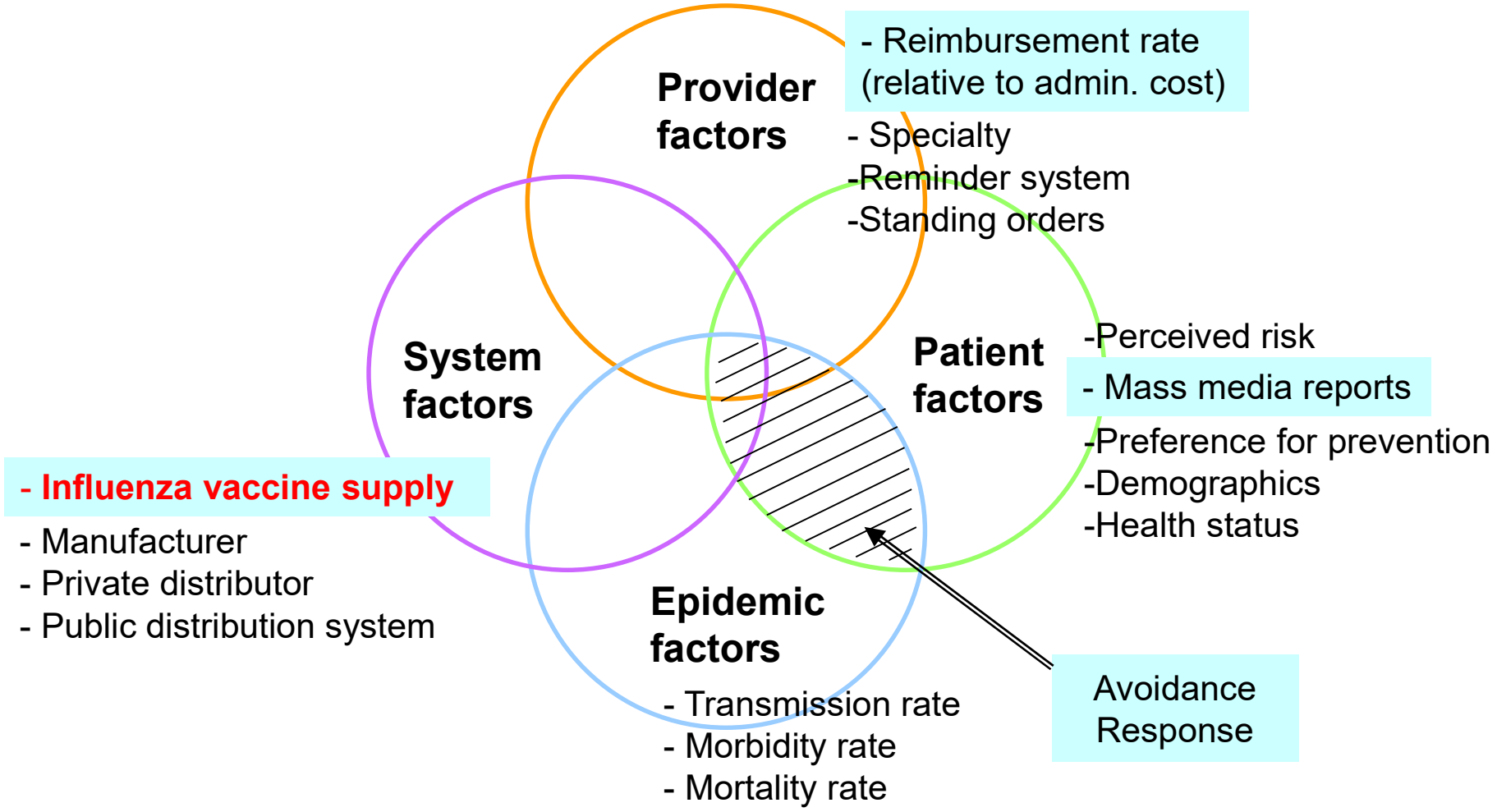
(Task Force on Community Preventive Services, MMWR 1999)



Does influenza vaccine supply delay/shortage affect racial/ethnic disparities?

(Yoo et al., *American J of Preventive Medicine*, 2011)

Background

Link et al did not find any change in racial/ethnic disparities during seasons with vaccine supply delay/shortage

- Comparing *different subjects* across consecutive seasons

→ Hard to judge if the cause is the changes in patients or those in system (or both)?

Methods: Very difficult general question

How to control *individual patient preference?*

e.g.1, I do not like any injection (i.e., fear of needle)

e.g.2, I do not like physicians/clinics

e.g.3, I believe that a vaccine causes autism or other very serious side effects

→ (If you are a reviewer) killing critique(?)

Does influenza vaccine supply delay/shortage affect racial/ethnic disparities?

(Yoo et al., *American J of Preventive Medicine*, 2011)

Methods (to control *individual preference*)

How about comparing the *same subjects* across seasons?

- Assuming individual preference is stable for 2 years

- (period 1) 2000-2001 and 2001-2002 seasons through (period 4) 2003-2004 and 2004-2005 seasons.

- Medicare Current Beneficiary Survey (MCBS) community-dwelling elderly (un-wt N =2,306–2,504, weighted N = 8.23-8.99 million).
- Multivariable logistic regression analyses
  - Outcome = flu shot receipt
  - Covariates = 15 individual level factors

Results

- Improved vaccine supply assoc. with
  ↓ racial/ethnic disparities in flu shot rates
  among nationally-representative Medicare elderly
  – 2%-11% compared with non-Hispanic White

- Worse supply assoc. with ↑ disparities
  – 2%-7% compared with non-Hispanic White

- "Dose-response" relationship b/w supply-change and disparity-change
  – "Largest disparity ↑" follows "largest supply↓"
  – "Smallest disparity ↑" follows "smallest supply↓"

Policy Implications

- Stabilizing the vaccine supply
  - Public buy-back plan: Buy un-used vaccines from manufactures and healthcare providers (public subsidy)
- The creation of an adult program similar to the Vaccines-for-Children (VFC) program
  - To sustain delivery of vaccines to safety-net providers with limited vaccine investment resources
  - Federally Qualified Health Centers and practices - serving large proportions of African-American and Hispanic patients
- Active provider and patient reminder/recall systems
- Targeted communication campaigns

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  - Media coverage on flu

V) Next Week

"Cost-effectiveness analysis of a television campaign to promote seasonal influenza vaccination among the elderly,"
Value in Health,
2015 Jul;18(5):622-630, (PMID: 26297090)
Kim M, **Yoo BK** (corresponding author)

Mentored as the first author's post-doctoral fellow training.

Journal Ranking

- **2018 Impact Factor: 5.037**
- **6th of 353 in Economics**
- **3rd of 79 in Health Policy & Services**
- **3rd of 94 in Health Care Sciences & Services**

Background

- Potential effectiveness of a TV flu shot campaign
  - Flu shot rate among US elderly: ↑ 2-8 percentage points due to TV reports on flu in 1999-2001 (Yoo et al. 2010)
- Preference on TV among elderly (65+ aged)
  - Spent 2.9~4.5 hours per day (half of leisure time) for watching TV in 2012 (Bureau of Labor Statistics 2012)
- Nationally representative data is available only among Medicare elderly (65+ age)

Research Objectives

- To determine the cost-effectiveness of "a hypothetical national TV flu shot campaign" targeting US Medicare elderly
  - Comparator: No "national TV flu shot campaign" (status quo)

- Key parameters in decision model:
  - Cost (2012 USD):TV campaign
  - Effectiveness: # of vaccinated Medicare elderly

Study Design 1

- Time horizon: 4 months (Sep. 1~ Dec. 31, 2012)
- Societal perspective
- Race-ethnicity specific cost-effectiveness:
  - Non-Hispanic White (W)
  - Non-Hispanic African American (AA)
  - English-speaking Hispanic (EH)
  - Spanish-speaking Hispanic (SH)
    (used Spanish in MCBS survey)

Study Design 2

- Intervention details:
  - 30-sec TV campaign for flu shot at prime time
  - Once a week during Sep. – Dec. (17 weeks)
  - Aired in 3 nationwide TV networks (ABC, CBS, NBC)

- Intervention cost (2012 USD):
  - Production cost (P): one-time cost
  - Broadcasting cost (B): 30-sec prime time cost
  - Total cost= P+[B*(17 weeks)*(3 networks)]

Study Design 3

- Threshold of cost-effectiveness
  - ICER <$38.47 [per vaccinated]
  - Standing order program in hospital settings among adults aged 19+ years (Honeycutt et al. 2007)

- Analyses
  - Deterministic analysis
    - Base case analysis
    - One-way sensitivity and break-even analyses
    - Probabilistic analysis (10,000 iterations)
  - Effect on the racial/ethnic disparity

Table 1: Model Inputs

Costs (2012 U.S. dollars)	Estimate	Range	Source
Total cost of TV campaign (=A+B*3*17)	$6 million	$4 million~ $10 million	
A: Production cost	$350,000		1
B: Broadcasting cost	$110,000	$74,000~ $189,000	1
TV Campaign impact on vaccination rate	**Estimate**	**Range**	**Source**
Non-Hispanic White	1.42%	0.53%~1.63%	2
Non-Hispanic African American	0.79%	0.73%~2.26%	2
Hispanic (English)	1.40%	0.58%~1.78%	2
Hispanic (Spanish)¶	(–)1.10%	(–)4.18%~3.07%	2

¶: Reduction in vaccination rate among Spanish-speaking Hispanics
1: Business websites
2: Our analysis from 1999-2001 Medicare Current Beneficiary Survey (MCBS) data

Table 1 (continued): Model Inputs

Medicare elderly population	Estimate	Range	Source
Total (2012)	39 million		3
Non-Hispanic White	83.3%		3
Non-Hispanic African American	9%		3
Hispanic (English)	4.2%		3, 4
Hispanic (Spanish)	3.5%		3, 4
Baseline vaccination coverage rate¶	**Estimate**	**Range**	**Source**
Non-Hispanic White	68%	63%~71%	5
Non-Hispanic African American	50%	40%~56%	5
Hispanic (English)	66%	58%~71%	4, 5
Hispanic (Spanish)	42%	31%~53%	4, 5

¶ Average and range of 14 seasons (1999 ~ 2012)

3: Centers for Medicare & Medicaid Services (CMS)

4: Yoo et. al. (2011) "Influenza Vaccine Supply and Racial/Ethnic Disparities in Vaccination Among the Elderly"

5: Centers for Disease Control and Prevention (CDC)

Figure 1: Decision Tree Model

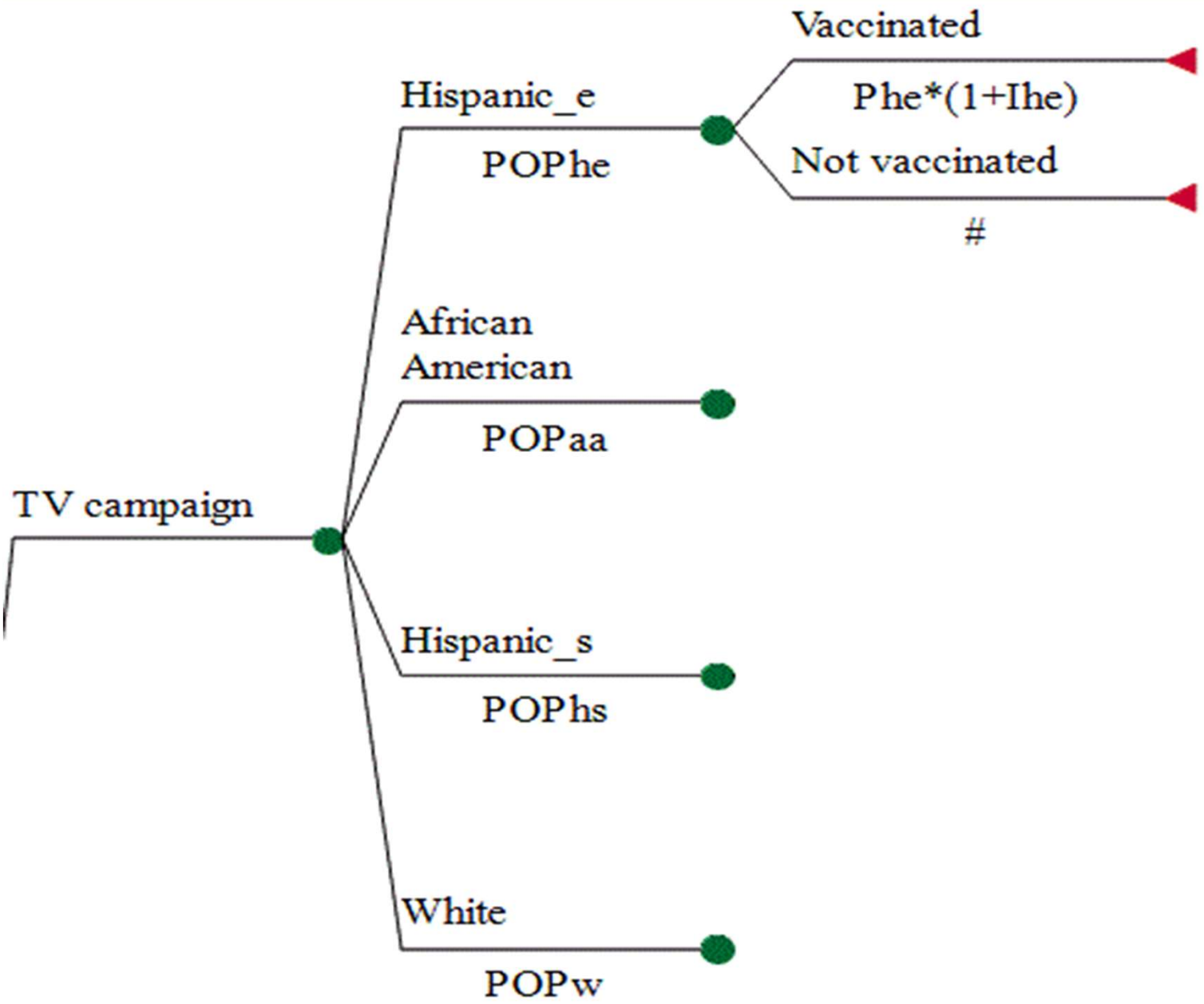


Table 2: Cost Effectiveness Analysis

Model	Incremental Cost [$ million]	Incremental Effect [persons]	ICER [$ per vaccinated]
Deterministic model	6.0 million	335,000	**$18**
Probabilistic model (95% CI)	6.7 million (4.7 m- 9.2 m)	300,000 (184,000, 378,000)	**$24 ($14- $40)¶**

All costs in US 2012 Dollars, ICER = Incremental Cost Effectiveness Ratio, #: Rounded at 1,000, 95% CI = 95% confidence interval, ¶: ICER<$38.47: 96.9% of 10,000 iterations

Table 3: Subpopulations: *Disparity in?*

Race/Ethnicity	Deterministic model	Probabilistic model
	ICER	**ICER (95% confidence interval)**
Non-Hispanic White	**$16**	**$23 ($13-$40)¶**
Non-Hispanic African American	**$39**	**$31 ($15-$53)¶**
Hispanic (English speaking)	**$17**	**$22 ($13-$40)¶**
Hispanic (Spanish speaking)*	Dominated	Dominated

All costs in US 2012 Dollars, ICER = Incremental Cost Effectiveness Ratio, #: Rounded at 1,000. * "TV campaign" was dominated by "without the TV campaign"
¶: ICER<$38.47: 96.9% (W), 78.9% (AA), and 97% (EH) of 10,000 iterations

Most groups: Cost effective (ICER < threshold of $38.47)

Result 2: *Disparity in?*

- Effect on Racial/Ethnic Disparity
  - W-AA groups: 0.6 pp ↑ in vaccination disparity
  - W-EH groups: 0.1 pp ↑ in vaccination disparity
  - W-SH groups: 1.5 pp ↑ in vaccination disparity

Discussion 1

- Reasons for disparity increase in vaccination rate among racial/ethnic groups
  - (i) English as a language barrier (SH group)

    → less likely to be exposed to English TV campaign
  - (ii) Limited vaccine supply (AA and SH group)

    → more likely to be delayed in vaccination

Discussion 2 (to be skipped)

- Nationwide TV campaign among elderly
  - Cost effective (ICER=$18~$24)
  - Spill-over effect on younger population (<65 years)
    → causes ICER ↓: more cost effective
  - Maximum acceptable campaign cost: $13 million
  - Easy to implement at national level

- Justifiable to implement the TV campaign
  - Need to include TV campaign in Spanish-language TV networks

Limitations (to be skipped)

- Not accounted for internet media
  - Elderly spent half of leisure time on watch TV in 2012 (Bureau of Labor Statistics 2012)

    → Still effective at least among elderly

- Uncertainty of effectiveness
  - (i) baseline vaccination rate
    - addressed by a range of 14 seasons vaccination rates (1999-2012)
  - (ii) a shortage or delay of vaccine supply
    - partly addressed by our analysis in three seasons; no/moderate/severe delay or shortage (1999-2001)

Conclusions

- Nationwide TV campaign is reasonably cost effective.
- Nationwide TV campaign may increase the racial/ethnic disparity.
- Nationwide TV campaign justifiable to implement, accompanying Spanish-language campaign

References

Yoo BK, Holland ML, Bhattacharya J, Phelps CE, Szilagyi PG. Effects of mass media coverage on timing and annual receipt of influenza vaccination among Medicare elderly. Health Serv Res. Oct 2010;45(5 Pt 1):1287-1309.

Wallace C, Corben P, Turahui J, Gilmour R. The role of television advertising in increasing pneumococcal vaccination coverage among the elderly, North Coast, New South Wales, 2006. Australian and New Zealand journal of public health. 2008 Oct;32(5):467-70.

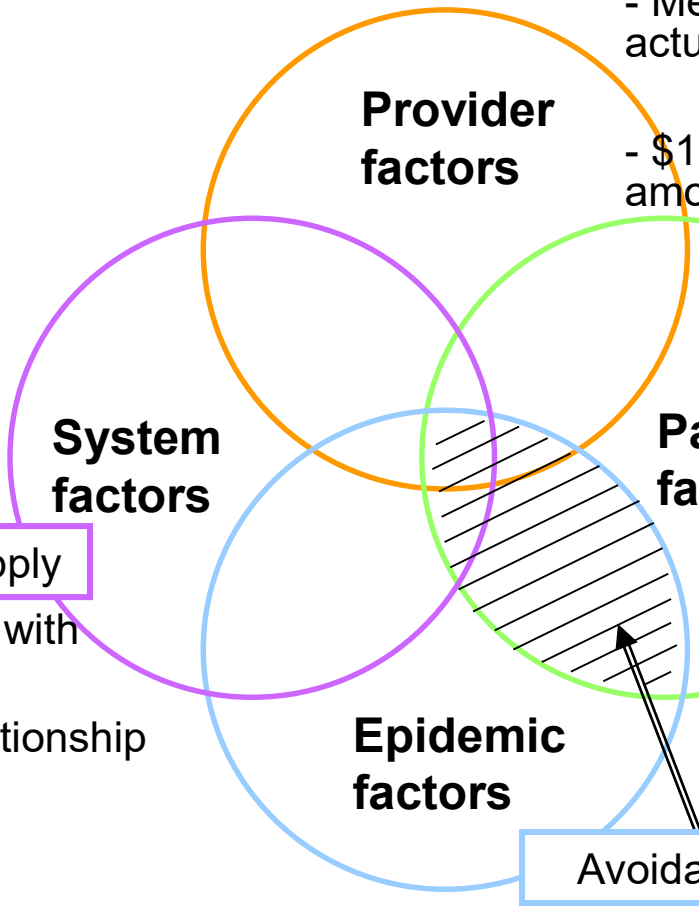
Bureau of Labor Statistics. Chart: Leisure time of individuals age 65 and over: employed vs. not employed. American Time Use Survey 2012 [cited 2014 June 4]; Available from: http://www.bls.gov/tus/charts/older.htm

Zimmerman RK, Santibanez TA, Janosky JE, Fine MJ, Raymund M, Wilson SA, et al. What affects influenza vaccination rates among older patients? An analysis from inner-city, suburban, rural, and Veterans Affairs practices. American Journal of Medicine. 2003 Jan;114(1):31-8.

Honeycutt AA, Coleman MS, Anderson WL, Wirth KE. Cost-effectiveness of hospital vaccination programs in North Carolina. Vaccine. Feb 9 2007;25(8):1484-1496.

Nguyen A, Western M. The complementary relationship between the Internet and traditional mass media: the case of online news and information. Inform Res. 2006 Apr;11(3).

Summary of Key Findings in 6 Publications



Reimbursement rate

- Median Medicaid rate ($8) smaller than actual administration cost ($20)

(Yoo et al., *Pediatrics,* 2009)

- $10 ↑ assoc. w 6-9% ↑ in flu shot rate among poor children (6-23 mo)

(Yoo et al., *Pediatrics,* 2010)

Mass media reports

# of reports (4 TV networks) assoc. with
- *earlier* vaccination timing
- ↑ in annual vaccination

(Yoo et al., *HSR,* 2010)

Influenza vaccine supply

-Worse supply assoc. with ↑ disparities

-"Dose-response" relationship

(Yoo et al., *AJPM*, 2011)

Avoidance Response

- ↑ in epi level assoc. w. ↑ in flu shot rate in following weeks (Yoo et al., *AJPH*, 2009)
- Better fitting forecasting model
- Change comparative effectiveness

(Yoo et al., *NBER*, 2010)

Take home messages

- Systematic analyses of health disparity
  - 1/2/3 prevention
  - Donabedian's model for quality care

- "Paradox in disparity"

  Disparity could be worsened by
  - Technological advancement
  - New information on disease/prevention/treatment
  - Insurance (and other?)

  → Because highest SES can gain the full benefits

  → How to mitigate/prevent the potential exacerbation of disparity?

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Next Week

- To discuss the options of policies and health (and information) technologies needed to tackle COVID19

→ Please prepare to (be forced to) discuss whether you agree/disagree with each option with your own reasoning

- Reading: OECD, "Testing for COVID19: A way to lift confinement restrictions," https://read.oecd-ilibrary.org/view/?ref=129_129658-l62d7lr66u&title=Testing-for-COVID-19-A-way-to-lift-confinement-restrictions

  (*Good news*!) Japanese version is available: OECD, "COVID19検査：外出制限措置を解除するために," https://www.oecd.org/tokyo/newsroom/ja%20Testing%20for%20Covid%20may%204%20rev.pdf

→ Please prepare to discuss in English

References

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Questions?