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Data, Methods, and Tips for Health Workforce Supply and Demand Modeling

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Goals

- To describe alternative approaches to health workforce supply and demand modeling at the national, state, and local levels
- To discuss data sources
- To share tips and best practices to help ensure study success

Agenda

- Terms and definitions
- Demand modeling
  - Evolution of health workforce modeling
  - Advantages and disadvantages of alternative approaches
  - Data and methods
- Supply modeling
  - Evolution of health workforce modeling
  - Advantages and disadvantages of alternative approaches
  - Data and methods
- Tips for improving workforce study success

Terms and Definitions

- Health care services
  - Demand: amount of services that people are willing to use at different price points
  - Utilization: actual use (usually analyzed in the form of medical claims)
  - Need: an informed opinion on the level of services that would be appropriate
- Workforce "requirements"
  - Demand: number and mix of health workers to meet demand for services
  - Need: an informed opinion on the number and mix of health workers to meet the need for services
    - Minimum need
    - Best practices

Terms and Definitions, cont.

- Supply
  - Licensed: health workers eligible to work
  - Active: health workers employed or seeking employment in an area that requires their clinical skills or knowledge
  - Full time equivalent (FTE): "standardized" measure of active supply taking into account part time workers
    - Example 1: Full time = 1 FTE; part time = ½ FTE
    - Example 2: FTE = average patient care hours worked among providers working at least 30 hours per week
- Adequacy of supply
  - Shortfall: Demand exceeds supply
  - Surplus (excess supply): Supply exceeds demand
  - Equilibrium: Supply equals demand (± X%)

Terms and Definitions, cont.

- Models

  "A model is a mathematical framework representing some aspects of reality at a sufficient level of detail to inform a clinical or policy decision" [1]

[1] Roberts M, Russell LB, Paltiel AD, Chambers M, McEwan P, Krahn M. Conceptualizing a model: a report of the ISPOR-SMDM Modeling Good Research Practices Task Force--2. Value Health 2012; 15(6):804-811

Demand Modeling

- Drivers of demand for services and providers
- Modeling approaches
- Data and model inputs

Drivers of Demand for Health Care Services

- Epidemiological factors (need, or perceived need)
  - Correlated with demographics (particularly age)
  - Correlated with other health risk factors (e.g., disease presence)
- Price and socioeconomic factors (ability/willingness to pay)
  - If a person has medical insurance, the correlation between use of health care services and household income largely disappears
- Health care system characteristics and economic considerations
  - Reimbursement/ what services are covered, value-based pricing
  - Provider-induced demand
  - Defensive medicine
- Technology (treatment possibilities)
- Societal norms and expectations

Drivers of Demand for Health Care Providers

- Demand for services
  - Mix of services by condition and care delivery setting
  - Complexity of services
- Provider characteristics
  - Scope of practice
  - Cost or relative value (e.g., physician assistant vs physician)

Models Differ in Approach, Complexity, and Value

Demand Models

Examples

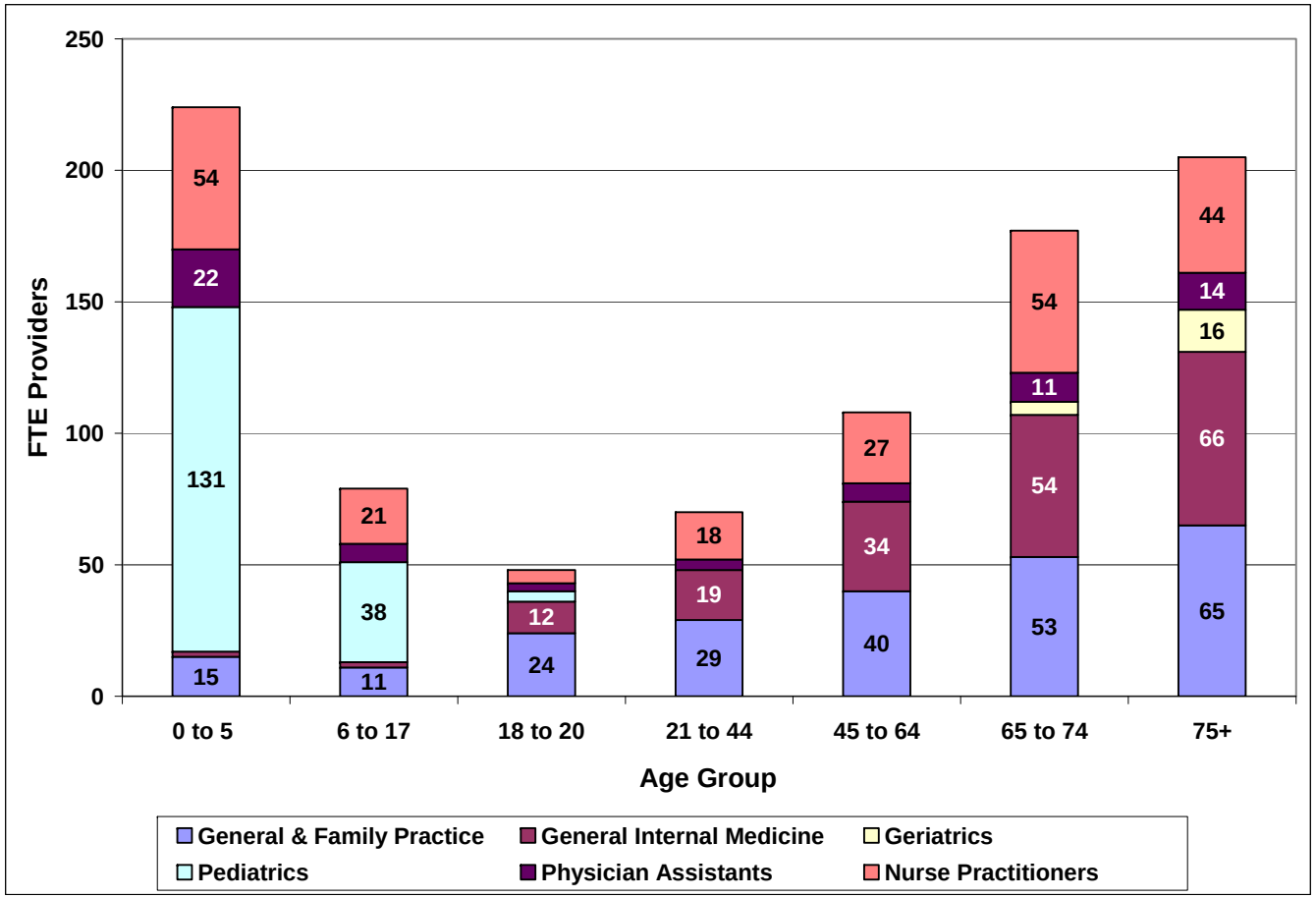
Weiner, HMO Model (1994)	Cooper, Trend Model (2002)	HRSA Models 1990s-2012	HRSA Models 2013+ IHS Models SHEPS Models

Needs-based Models

Examples

HRSA HPSA designations	GMENAC(1970s)	Application of HRSA, IHS, SHEPS models

FTE Practitioner Use per 100,000 Population, by Age Group (based on utilization patterns)



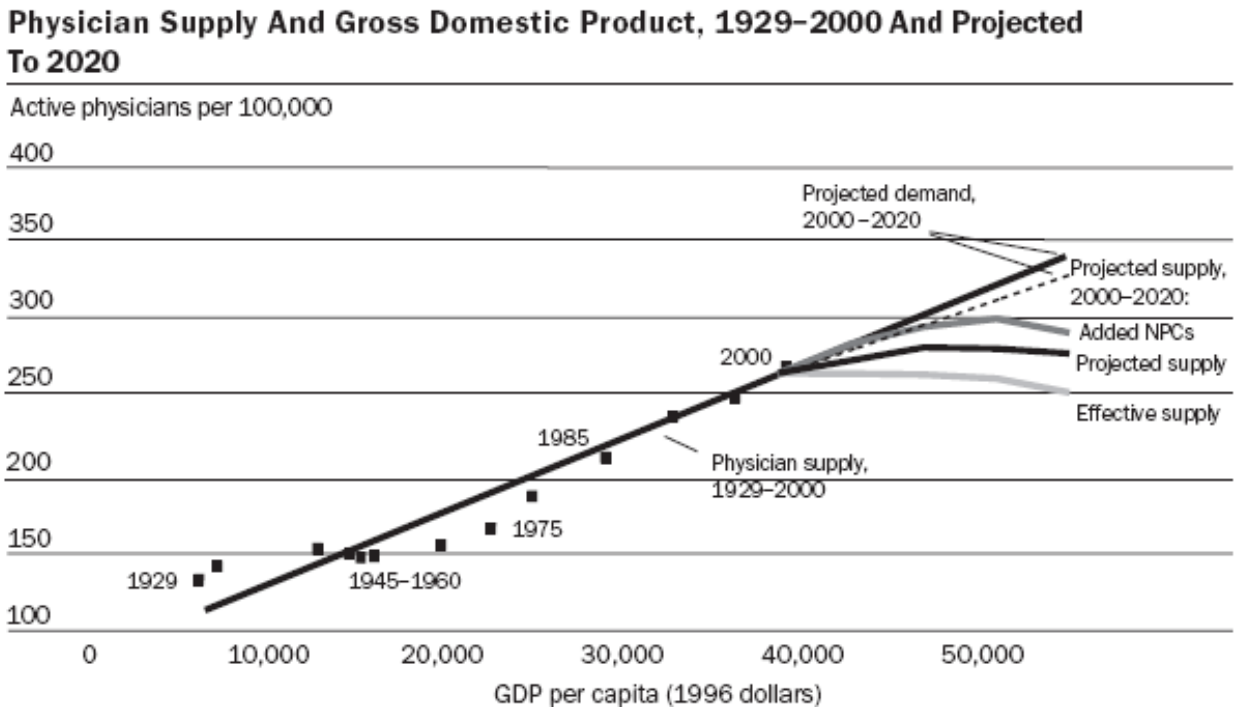
HRSA (2013): Projecting the Supply and Demand for Primary Care Practitioners Through 2020
http://bhpr.hrsa.gov/healthworkforce/supplydemand/usworkforce/primarycare/projectingprimarycare.pdf

Demand for FTE Primary Care Providers/10K Population

- Non-Hispanic, black, female, age 75+, insured, with diabetes, with hypertension, obese: **26** FTE/10,000 population
- Non-Hispanic, black, female, age 75+, insured, no diabetes, no hypertension, normal weight: **8.6** FTE/10,000 population
- Non-Hispanic, black, male, age 18-34, insured, with diabetes, with hypertension, obese: **5.9** FTE/10,000 population
- Non-Hispanic, black, female, age 18-34, insured, no diabetes, no hypertension, normal weight: **2.4** FTE/10,000 population

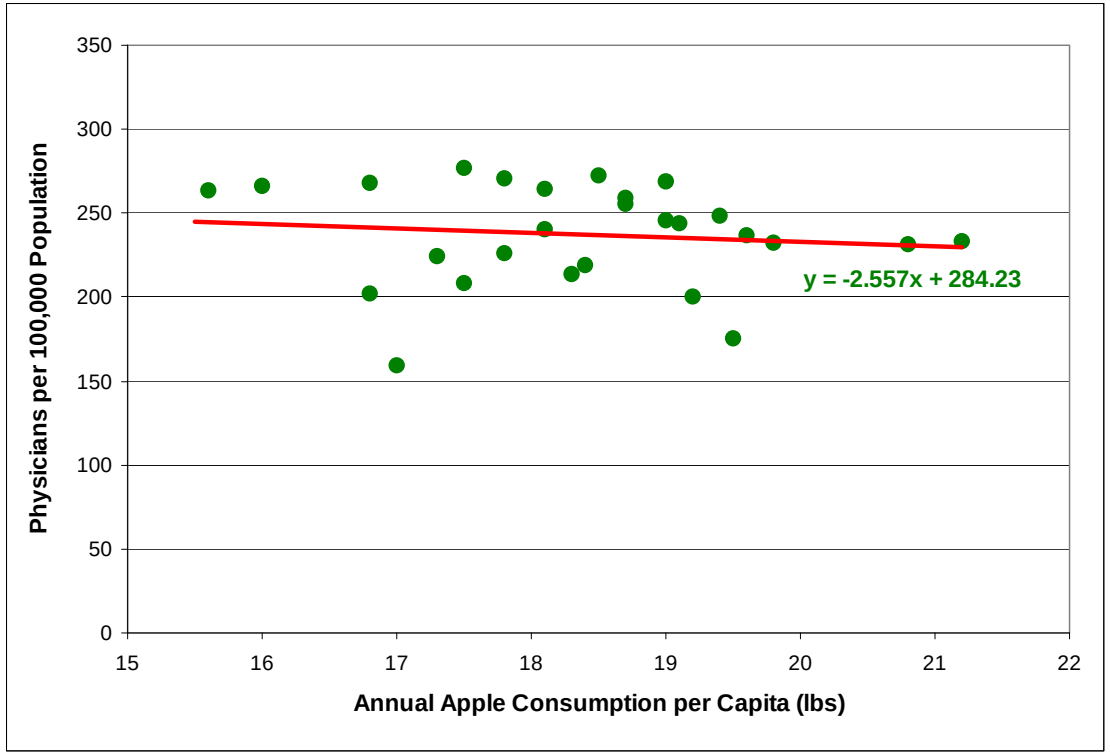
Cooper's Economic Trend Model

- Cooper et al., 2002. Economic and Demographic Trends Signal an Impending Physician Shortage. *Health Affairs*. 21(1):140-154.
  - Healthcare system too complex to model, so identify few key drivers of demand
  - Our demand is limited primarily by our ability to pay for services
  - "The major trend affecting demand for physician services is the economy." (income elasticity = 0.75)
  - "Population growth is a second major factor that affects demand for physicians."



Tim's Apple Trend Model

- Key findings
  - A major trend affecting demand for physician services is apple consumption
  - Consumption of 118,000 apples reduces physician demand by 1
  - National per capita consumption of an apple/day reduces physician demand to zero
- Key implication
  - "An apple a day keeps the doctor away"

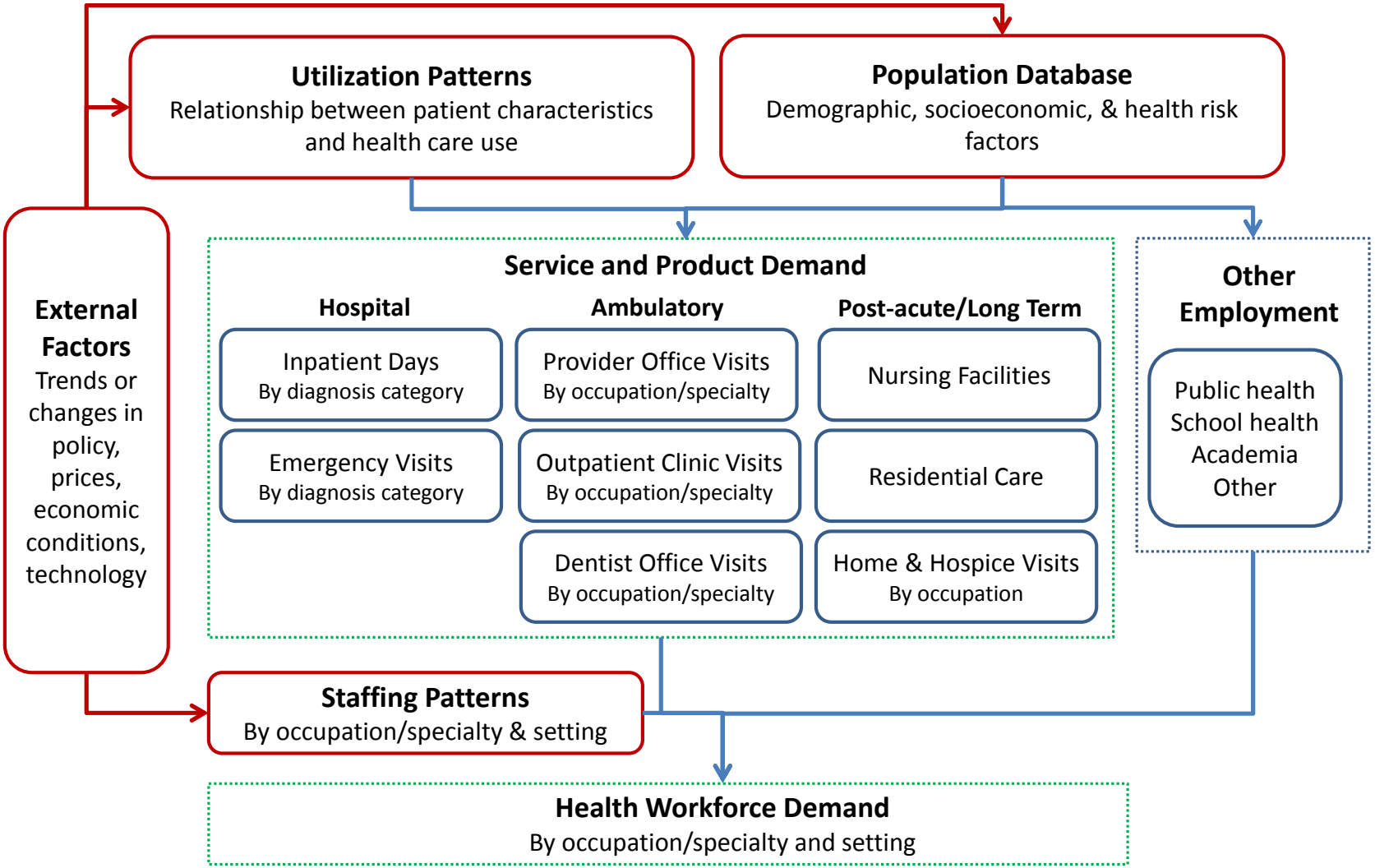


Source: Analysis of per capita apple consumption: 1970 - 2004

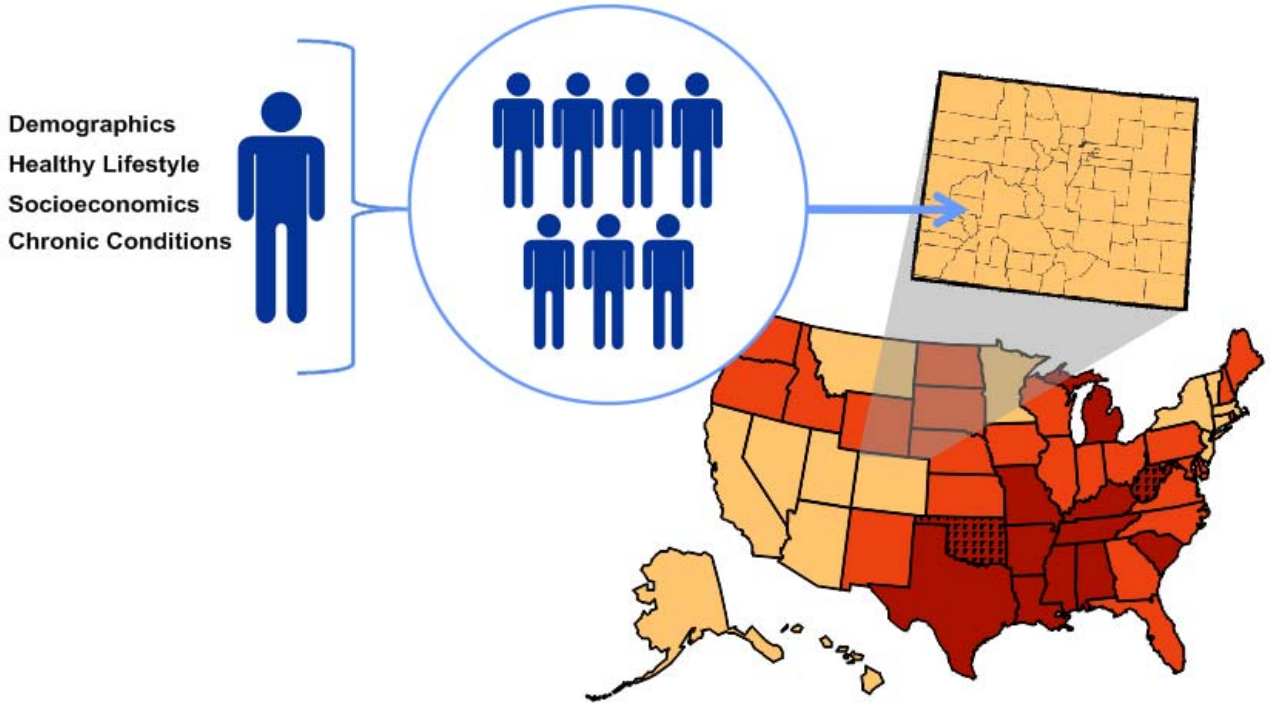
Limitations of Historical Approaches to Modeling Demand

- Population averages (provider-to-pop ratios) inflexible for modeling
  - Geographic variation in health risk factors other than demographics
  - Paradigm shifts in care delivery
  - Policy changes such as Health Care Reform
- Few demand drivers (demographics, income, insurance, HMOs)
- Reliance on key assumptions (e.g., economic growth, HMO growth)
- Expert panel limitations
  - Convolution of "need" versus "demand"
  - Bias: e.g., physicians and nurse practitioners likely have very different views on scope of practice and implications for provider demand
- Static models
  - Utilization is independent of supply
  - Provider demand is independent of other "factors of production"

Healthcare Demand Microsimulation Model: Overview



Develop Representative Sample of Current and Future Population to Model Demand



Combines:

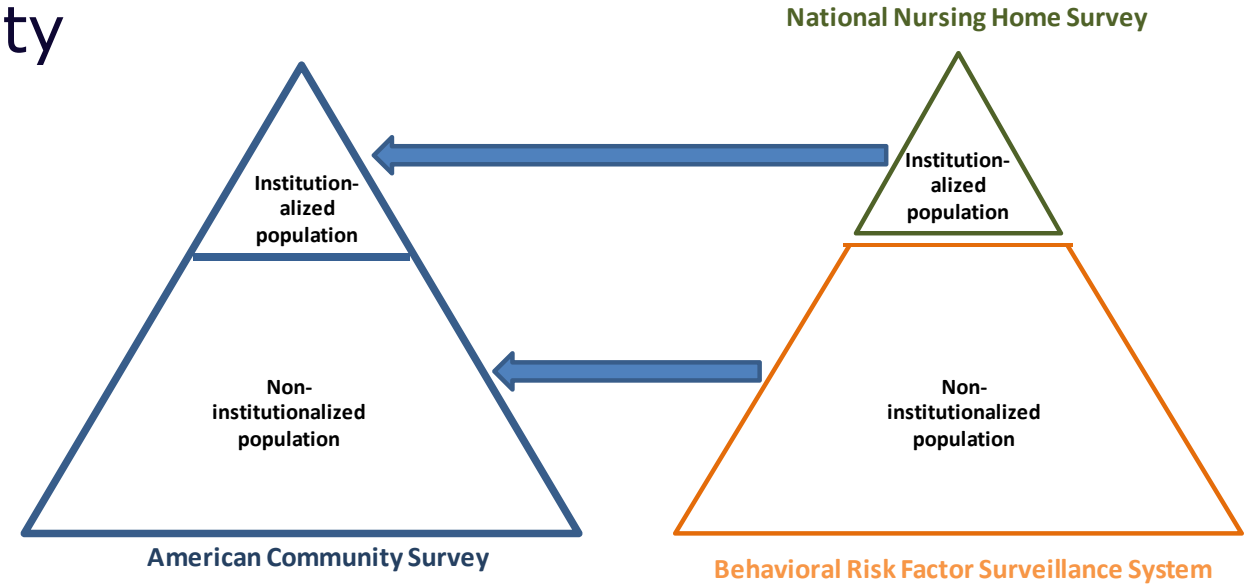
Behavioral Risk Factor Surveillance System (BRFSS)

American Community Survey (ACS)

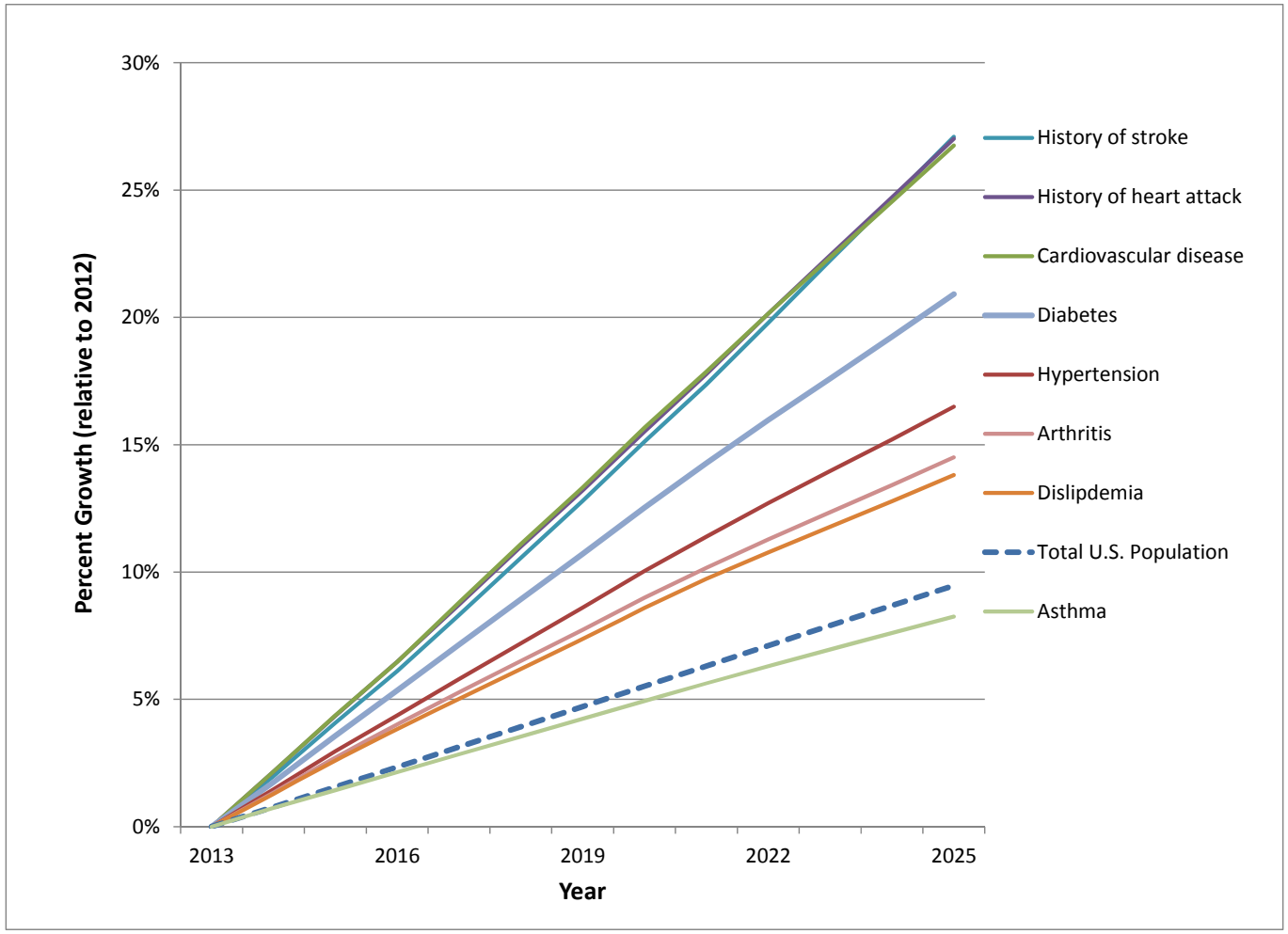
National Nursing Home Survey (NNHS)

Create Population Database

- ACS-BRFSS match based on same state, age group, gender, race/ethnicity, income level, insurance status
- ACS-NNHS match based on same age group, gender, race/ethnicity



Project Demand for Services: Chronic Disease Example



Source: Dall et al., 2013, Health Affairs

Example: Healthcare Utilization for Cardiologist and Cardiology-Related Services

[1] Rate ratios from Poisson regression analysis using 2006-2010 Medical Expenditure Panel Survey (MEPS).

[2] Odds ratios from logistic regression analysis using 2006-2010 MEPS.

Statistically significant at the 0.05 (*) or 0.01 (**) level.

	Parameter	Office Visits[1]	Outpatient Visits[1]	Emergency Visits[2]	Hospitalization[2]
Race-Ethnicity	Hispanic	0.78**	0.67**	1.02**	0.86**
	Non-Hispanic black	0.73**	2.15**	1.41**	1.34**
	Non-Hispanic white	0.93**	1.31**	0.96**	0.97**
	Non-Hispanic other race	1.00	1.00	1.00	1.00
	Male	1.13**	1.62**	0.92**	0.99
Age	18-34 years	0.13**	0.12**	0.45**	0.25**
	35-44 years	0.32**	0.59**	0.84**	0.53**
	45-64 years	0.53**	0.72**	0.83**	0.69**
	65-74 years	0.88**	1.35**	0.91**	0.90**
	75+ years	1.00	1.00	1.00	1.00
	Smoker	0.77**	0.62**	0.97	0.95
Diagnosed With	Hypertension	1.34**	1.31**	2.50**	1.91**
	Coronary heart disease	7.03**	6.37**	2.60**	3.39**
	History of heart attack	1.61**	1.90**	2.59**	2.58**
	History of stroke	1.07**	0.80**	2.38**	2.53**
	Diabetes	1.18**	1.51**	1.08**	1.25**
	Arthritis	1.02**	1.32**	0.94**	0.89**
	Asthma	1.04**	1.06**	1.05*	1.09**
	History of cancer	1.15**	0.83**	0.93**	0.91**
	Insured	1.56**	1.14**	0.76**	0.99
	Medicaid	1.29**	1.59**	1.57**	1.42**
Household Income	< $10,000	0.89**	0.64	1.66**	1.53**
	$10,000 to < $15,000	0.83**	0.64**	1.36**	1.51**
	$15,000 to < $20,000	0.85**	0.86**	1.10**	1.28
	$20,000 to < $25,000	0.93**	0.39**	1.35*	1.32
	$25,000 to < $35,000	0.88**	0.78**	1.56**	1.36**
	$35,000 to < $50,000	1.03**	0.69**	1.17**	1.16**
	$50,000 to < $75,000	0.99	0.80**	1.06**	1.09**
	$75,000 or higher	1.00	1.00	1.00	1.00
Body Weight	Not available	0.89**	0.89**	2.26**	1.98
	Normal	0.97**	0.97	1.14**	1.02
	Overweight	1.00	1.00	1.00	1.00
	Obese	1.04**	0.69**	1.09**	1.12
	Metro area	1.35**	0.94**	1.04	0.93

Distribution (%) of Nurses Across Employment Settings

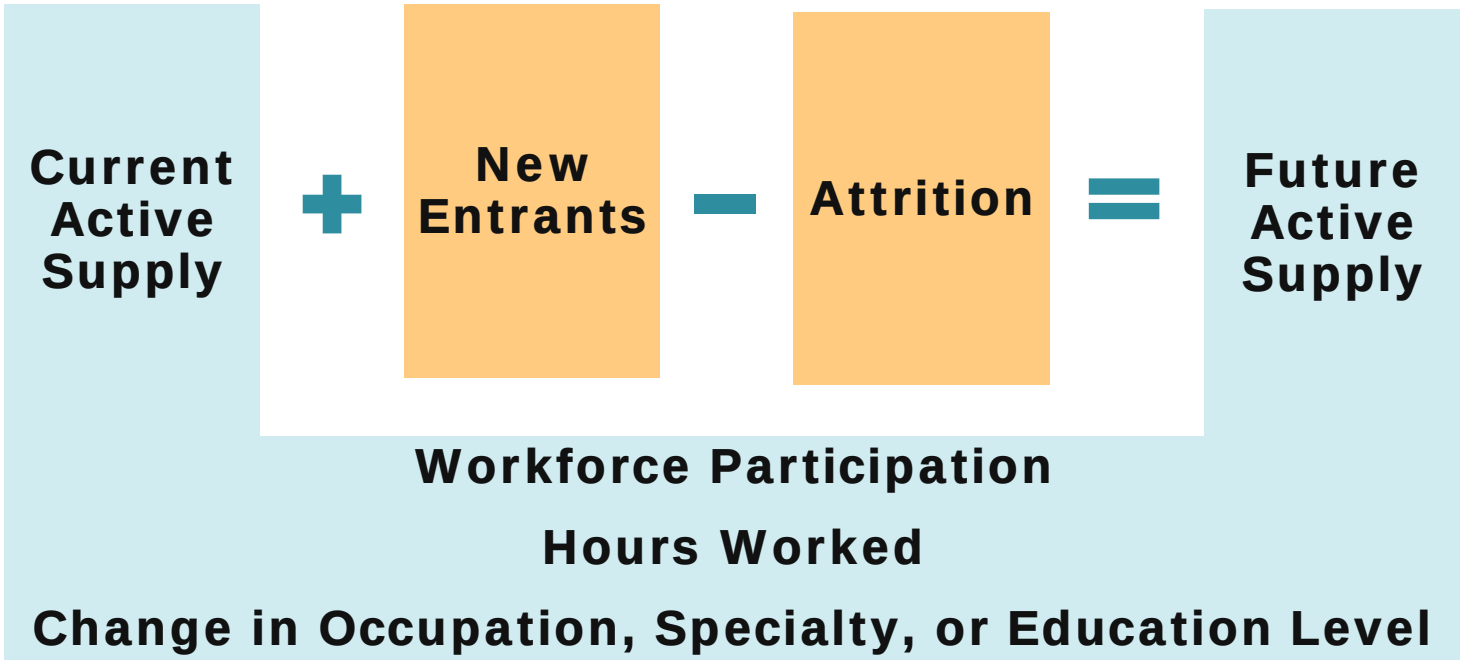
	RNs				LPNs
	OES [a]		2008-10 ACS [b]	2008 NSSRN [c]	2008-10 ACS [b]
Work Setting	2012	2010			
Hospitals	62.0	60.4	63.2	62.2	29.3
Inpatient [e]	55.6	54.1	56.6	55.7	
Emergency [e]	6.4	6.3	6.6	6.5	
Offices	7.4	9.8	5.1	10.5	8.6
Outpatient	4.0	4.5	4.6		5.7
Home health	6.2	5.5	3.8	6.4	6.3
Government	5.6	5.8			
Nursing care facilities (skilled/long term)	5.3	5.1	7.4	5.3	30.7
Residential care facilities	1.7	1.6	0.4		1.3
Nurse education	3.1	1.2	0.6[d]	3.8	0.3 [d]
School health	1.9				
Social work	0.7	0.7			
Public/community health				7.8	
Other	2.2	5.4	14.9	3.9	17.8
Total [f]	**100**	**100**	**100**	**100**	**100**

Sources and notes: [a] Occupational Employment Statistics. [b] 2008-2010 pooled files of the American Community Survey, reported in HRSA 2013 nursing report. [c] 2008 National Sample Survey of Registered Nurses. [d] Nurses in teaching positions might be recorded in the ACS under teaching rather than under nursing. [e] Estimated based on estimate that 89.6% of hospital nurses are working in inpatient settings and 10.4% are working in emergency settings, with nurses in administration allocated proportionately across settings (from the 2008 NSSRN). [f] Numbers might not sum to 100% because of rounding

Care Delivery Patterns: Converting Service Demand to Health Profession FTEs

- Translate demand for health care services into full time equivalent (FTE) providers
  - Example: 1,000 ambulatory visits to a pediatrician equates to approximately 0.23 FTE pediatrician; 1,000 hospital rounds equates to approximately 0.48 FTE pediatrician
- Data sources
  - Occupation/specialty/setting specific surveys and studies
  - National organizations (e.g., Medical Group Management Association's Physician Compensation and Production Survey)
  - National ratios (e.g., home health aides to home health visits)
  - Reported statistics (e.g., nurse staffing ratios in nursing homes)

Conceptual Model for Health Workforce Supply



Modeling Health Care Supply: Traditional Approach

- "Cohort" or "Inventory" model
  - By profession, age, gender, location (e.g., state), other (e.g., education level)
  - Estimate supply components (by provider characteristics)
    - # current providers
    - # new entrants to the health workforce each year
    - # retirements each year
    - Average hours worked
- Framework
  - Supply generally modeled separate from demand; static versus dynamic
  - Cohort averages applied (e.g., retirement probability, hours worked)
  - Cohort approach usually works fine for general forecasting

Microsimulation Approach to Supply Modeling

- Individual providers are unit of analysis
- Start with database of providers
  - Characteristics similar to cohort approach: age, gender, specialty/occupation, location
- Simulate provider choices (e.g., specialty, location, hours, retirement) over career
  - Estimate choice probability as function of provider characteristics and external factors
  - Example: work location choice is function of
    - Provider characteristics (age, gender, specialty, IMG)
    - Location characteristics (shortfall/surplus, earnings potential, other)
    - Policies (e.g., state scope of practice regulations for NPs/PAs)
  - Compare probability to random number generator to simulate choices
- New graduates: "create" new individuals
  - Characteristics reflect distribution of current/future graduates in terms of age, gender, specialty/occupation

Strengths and Limitations of Alternative Supply Approaches

Features	Traditional (Cohort) Approach	Microsimulation Approach
Simplicity	Simpler	More complex
Data needs	Fewer data needs	Greater data needs
Flexibility for modeling policies and trends in supply determinants	Less flexible	More flexible
Static versus dynamic: • Integrate supply & demand • Integrate economic factors	Less flexible	More flexible
Research needs	Compute averages	Regression analysis or other approaches to calculate model parameters
Accessibility	Can be developed in MS Excel spreadsheet	Requires more powerful software (e.g., SAS)

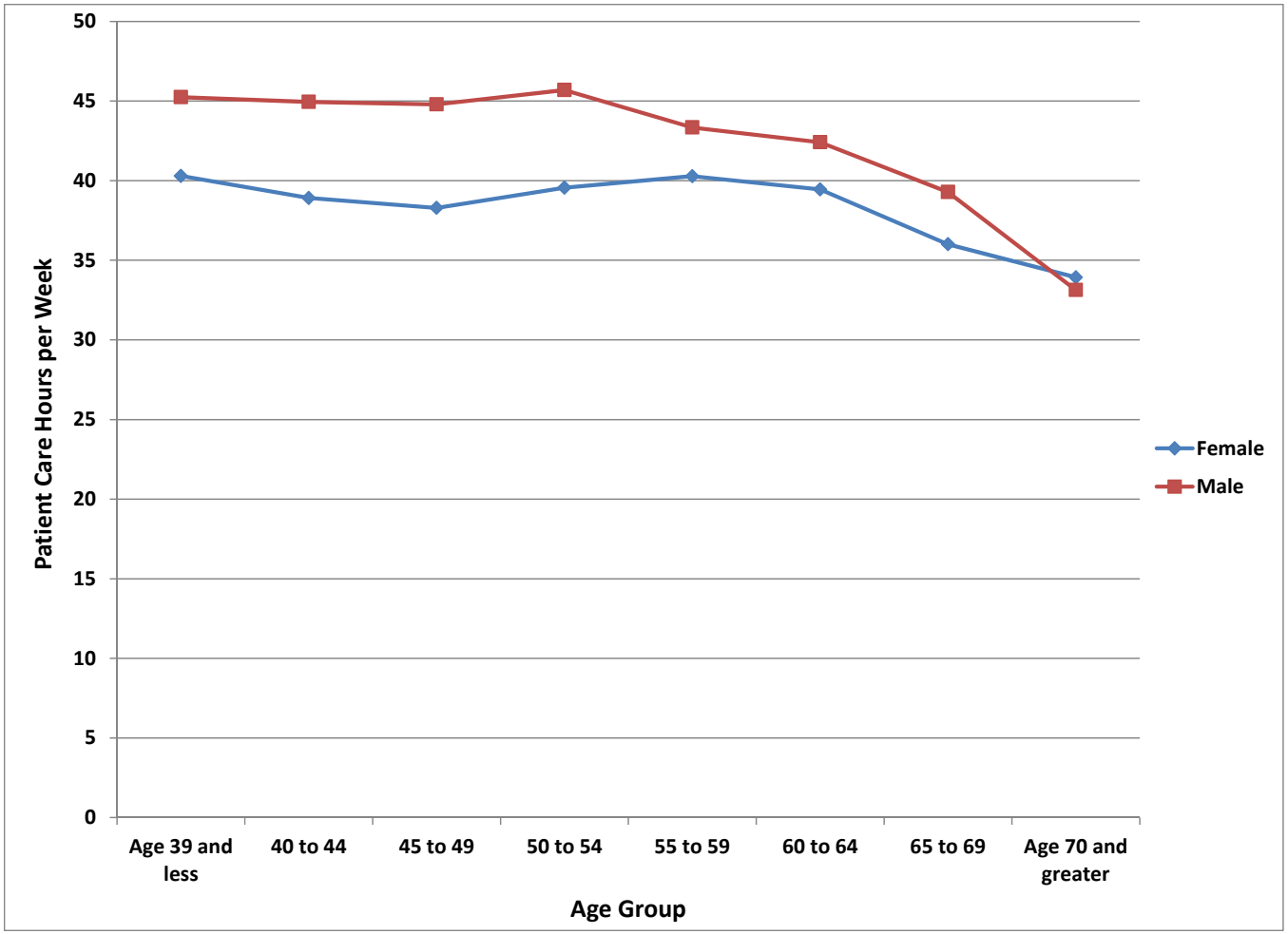
Supply-Related Data Sources

- State licensure files
  - Many states collect valuable information via survey at relicensure
- National and profession surveys
  - American Community Survey
  - HRSA Nurse Practitioner survey
  - AAMC Physician Workforce Survey
  - Individual profession surveys
- Association/licensure databases
  - American Medical Association Masterfile
  - American Dental Association Masterfile
  - National Commission on Certification of Physician Assistants Masterfile
- Integrated Postsecondary Education Data System (IPEDS)

Prediction Equations for Supply Decisions

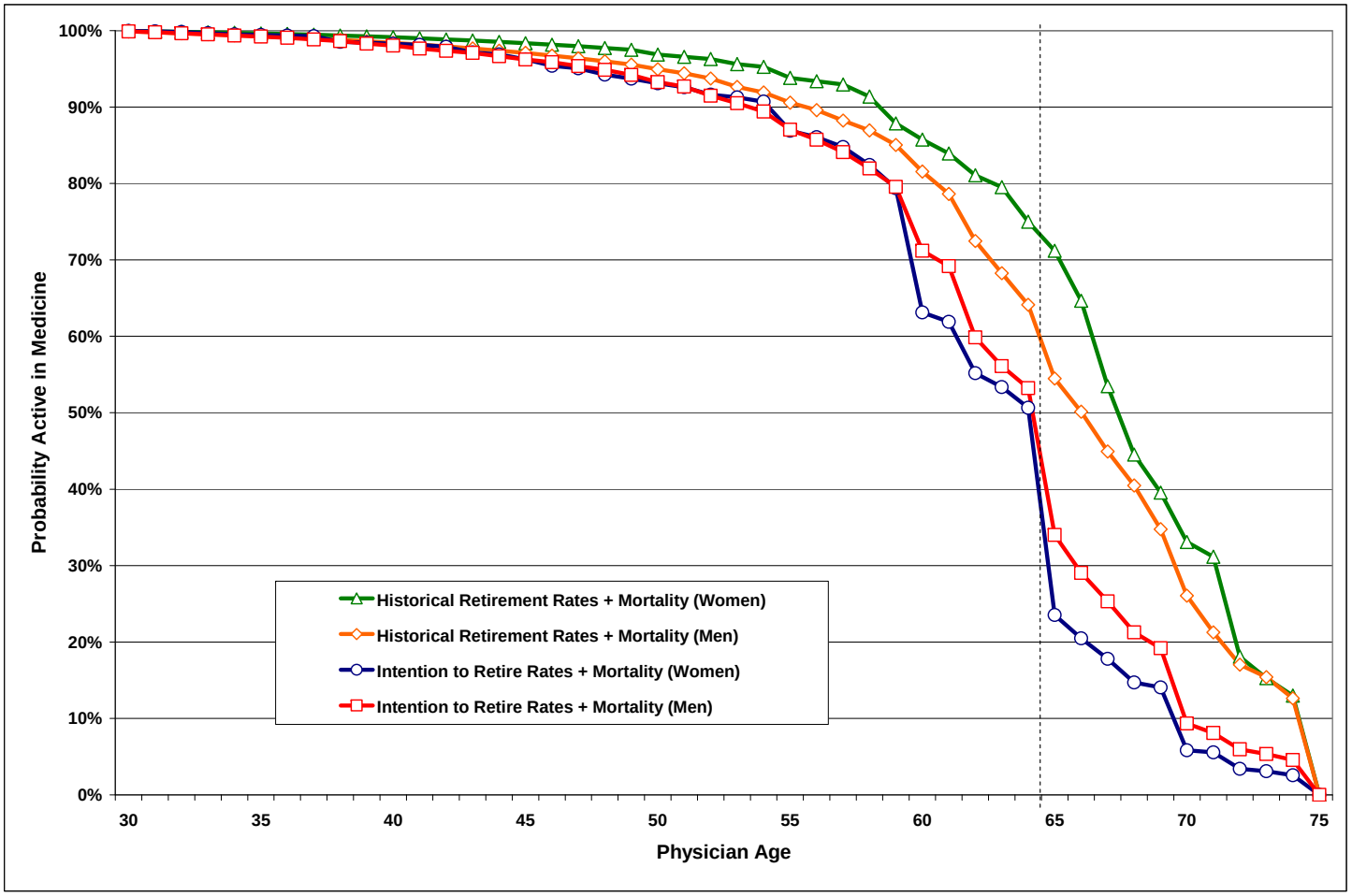
- Supply data analyzed
  - American Community Survey for non-physicians
  - Profession-specific data (e.g., AMA Masterfile, ADA Masterfile)
- Modeling approach
  - Linear/non-linear regression models
  - Potential hourly earnings
    - Estimated using data on average earnings of employed people in same profession and geographic area, and person's characteristics
  - Hours worked, probability active, separation rates
    - Estimated using data on age group, gender, unemployment rate, and potential hourly earnings
      - Working to incorporate local estimates of adequacy of supply (PUMA level, Public Use Micro Area)

Average Weekly Patient Care Hours Across Primary Care Physician Specialties



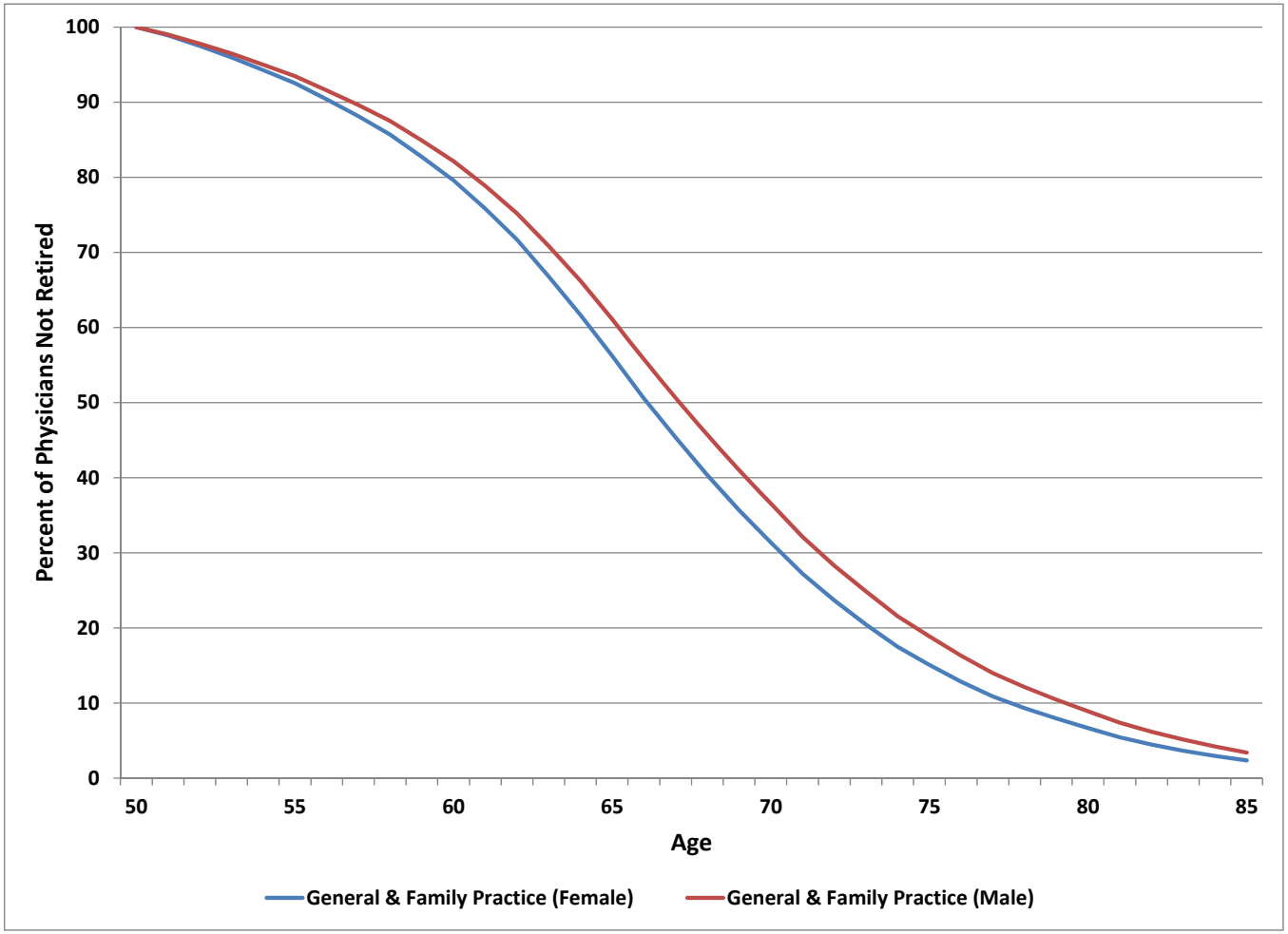
Source: FL Physician Survey, 2012-1013

Physician Retirement Rates



Source: Analysis of the 2006 AAMC Survey of Physicians Over Age 50, combined with CDC mortality rates.

Workforce Attrition for General & Family Practice Doctors in FL



Sources: CDC mortality rates combined with FL survey data (intention to retire in next 5 years)

RESOURCES AND TIPS FOR SUCCESSFUL WORKFORCE STUDY

Resource: State/Researcher Access to Nursing Component of Web-Based Workforce Model

- Web-based version of model currently being developed by HRSA and will be beta tested with select states
  - States have access to more accurate nurse workforce data through licensure process
  - States will have ability to upload their minimum data sets for nursing
  - States will have ability to run supply and demand scenarios related to nursing

Tips for Successful Study

- Up front, clearly define goals of the study
  - Primarily interested in forecasting? Interest in policy analysis?
- Use an advisory committee that includes clinicians
- Beware of small specialties (small sample size issues)
- Give the supply data a thorough cleaning
  - Some licensed providers might not be actively practicing even if their records indicate they are active
  - New licenses to the state workforce might include physicians in GME who do not intend to practice in the state, locum tenens, retirees
- Conduct sensitivity analyses and stress tests with the model
- Use the peer review process to check your proposed approach and findings
- Models and projections need periodic updating and refinement
  - Consider future data availability