Geographic Access, Equity, and Impact on Quality

Mammography and Breast Cancer Screening

Tracy Onega, PhD, MA, MS
Associate Professor, Geisel School of Medicine
Departments of Biomedical Data Science and Epidemiology
The Dartmouth Institute for Health Policy & Clinical Practice

Geography as a Health Care Determinant

Access → Utilization → Outcomes

Breast Imaging Interpretation Quality

Disparities in Breast Cancer Screening and Outcomes

Access → Utilization → Outcomes

% Women with Travel Time > 30 min.to Closest Mammography

White	12.6%
Black	6.4%
Asian	2.2%
Native Am.	39.6%
Urban	0.5%
Rural	27.9%

Onega et al. JACR, 2014

% Women 40+ yrs. with Mammo In past two years (BRFSS)

White	75.4%
Black	78.6%
Asian	73.7%
Native Am.	63.9%
≥$75,000/yr.	83.8%
<$35,000/yr.	68.1%

Miller JW, et al. MMWR, 2012

% Late Stage Breast Cancer (Stage III and IV) at diagnosis

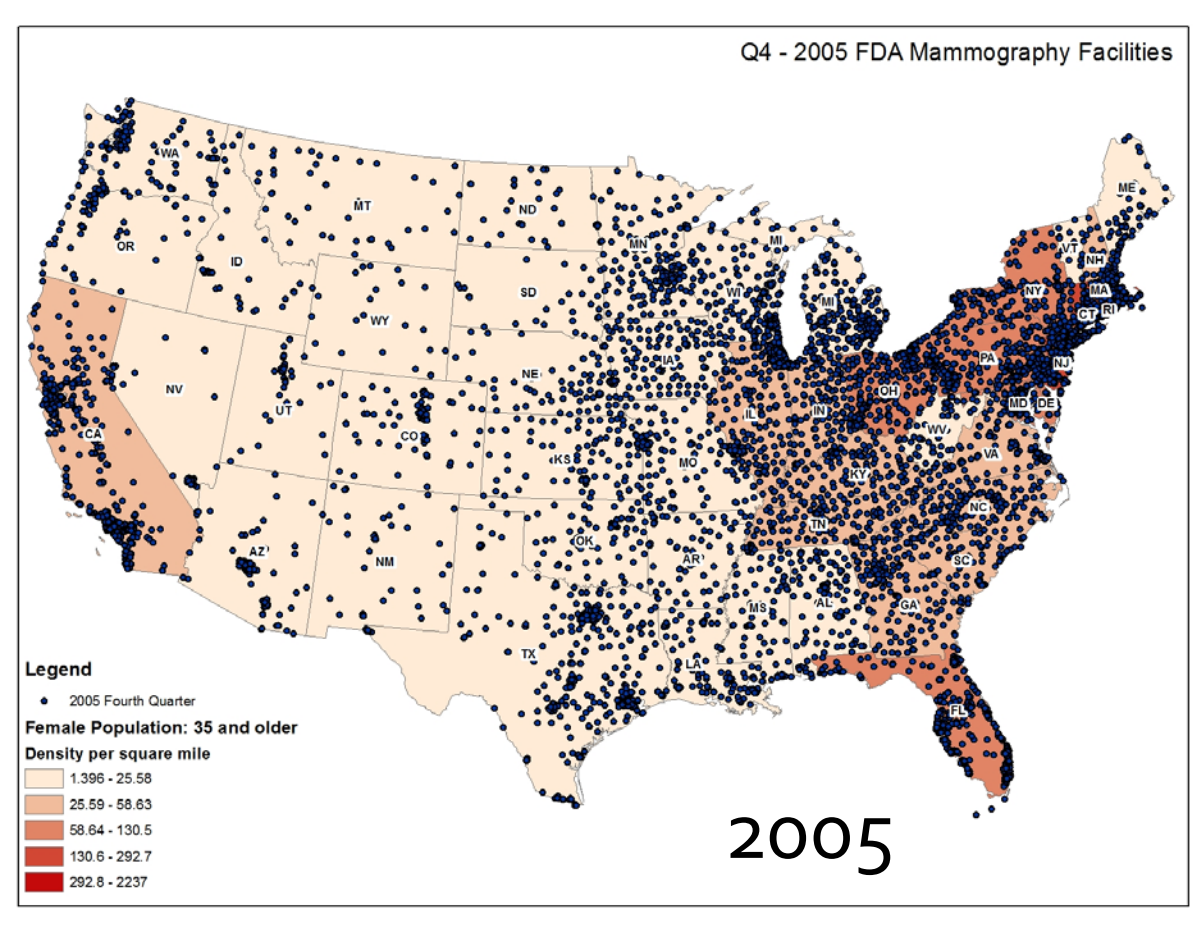
White	7.6%
Black	11.2%

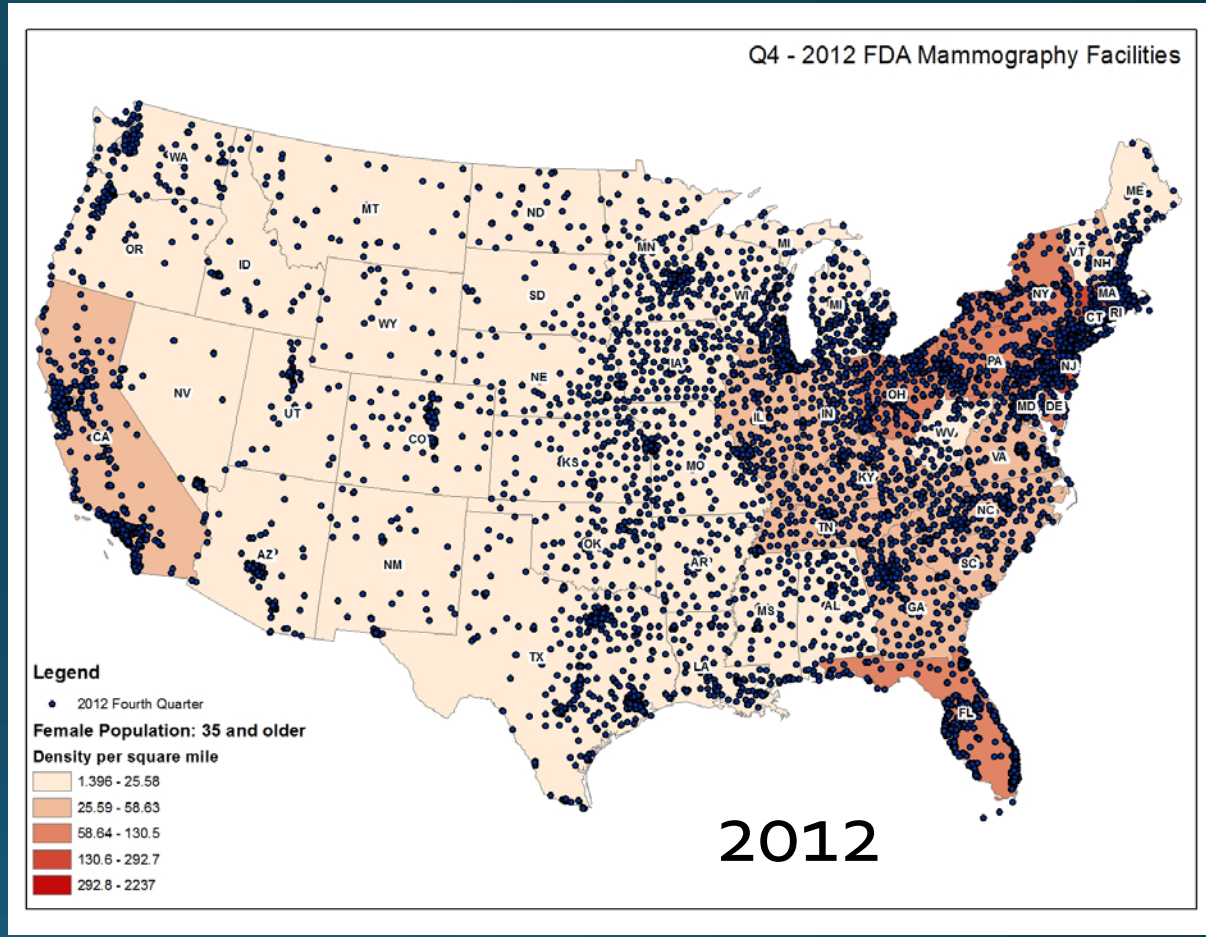
Breast Cancer Mortality rates (per 100,000)

White	22.7
Black	30.8
Hispanic	14.8

American Cancer Society, 2013-2014

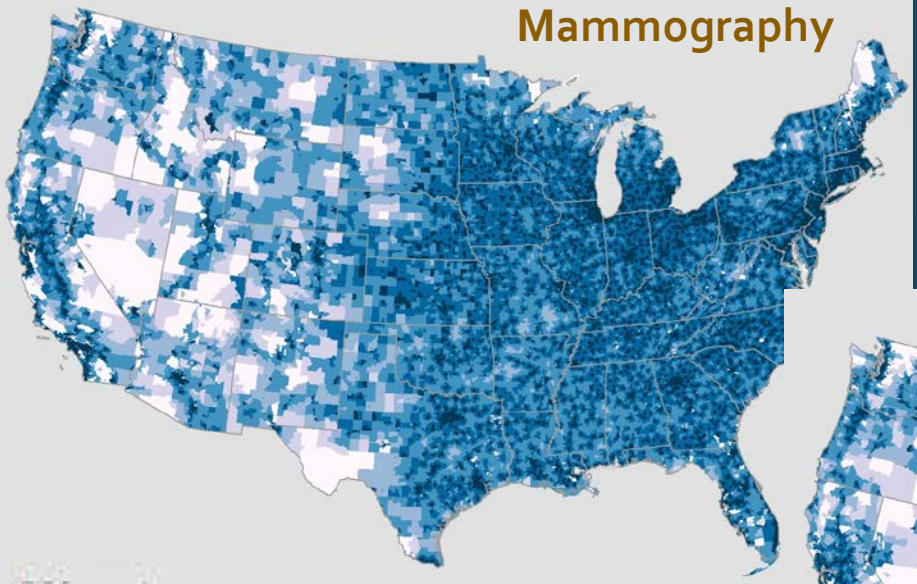
Geographic Distribution of Mammography

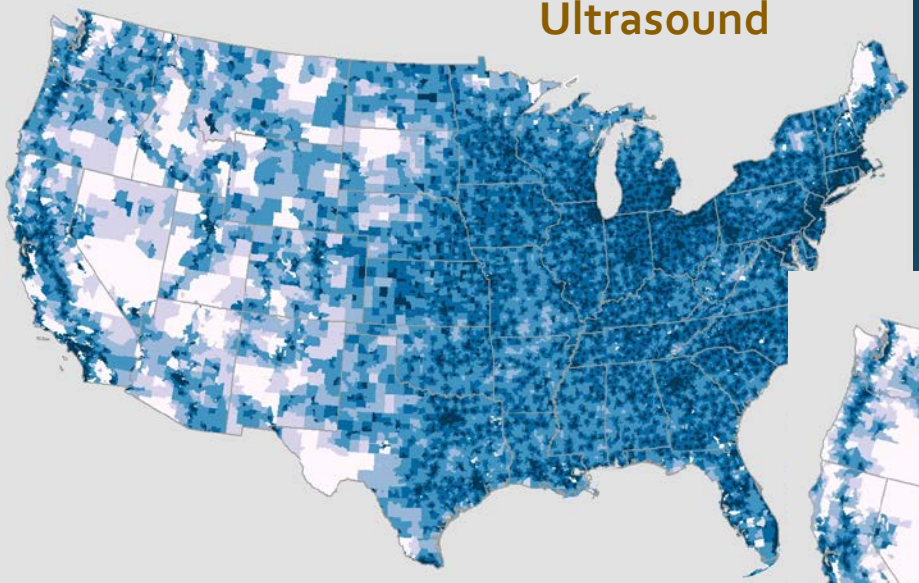


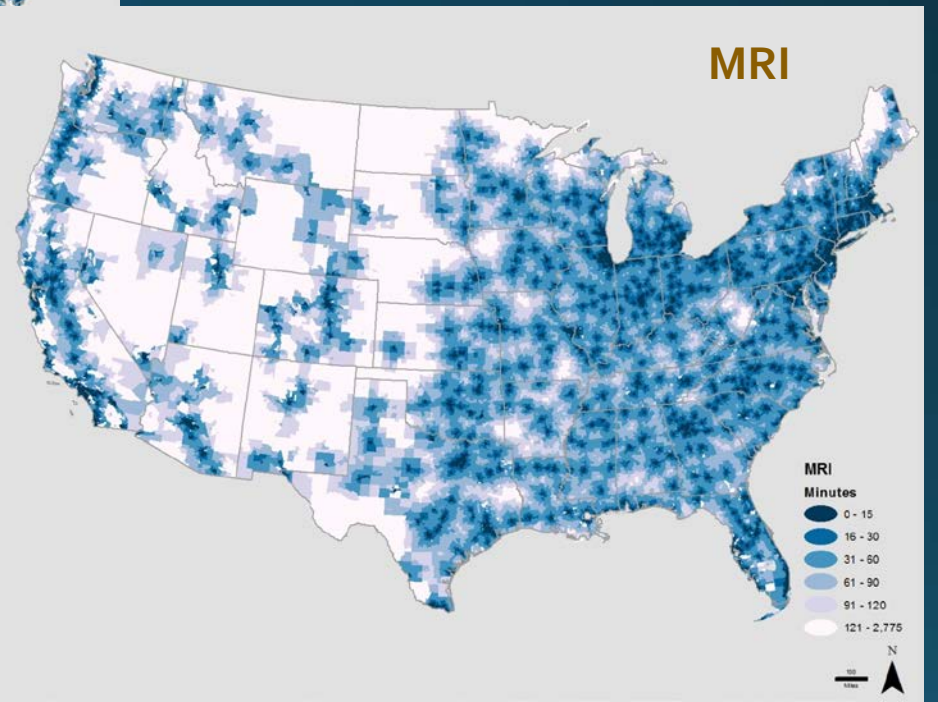


Geographic stability and 'full' dissemination

Geographic Distribution of Other Breast Imaging







Minutes
0 - 15
16 - 30
31 - 60
61 - 90
91 - 120
121 - 2,775
N
100

Median Travel Time (IQR)

In Minutes

Mammo	6 (4-13)
US	6 (4-13)
MRI	10 (5-26)

Onega et al. JACR 2014

Geographic Distribution of Other Breast Imaging – Facility Level

Facility Characteristic	Any US	Any MRI	Any Image-guided Biopsy	Combination of US, MRI,and Image-Guided Biopsy
Profit status				
For profit	87%	48%	32%	18%
Not for profit	77%	40%	65%	34%
Academic affil.				
Yes	75%	75%	75%	75%
No	80%	40%	58%	29%
Practice Type				
Multi-specialty breast center	100%	76%	96%	76%
Full diagnostic radiology	82%	39%	59%	22%
Breast imaging only	50%	0%	0%	0%
Non-radiology	22%	0%	0%	0%

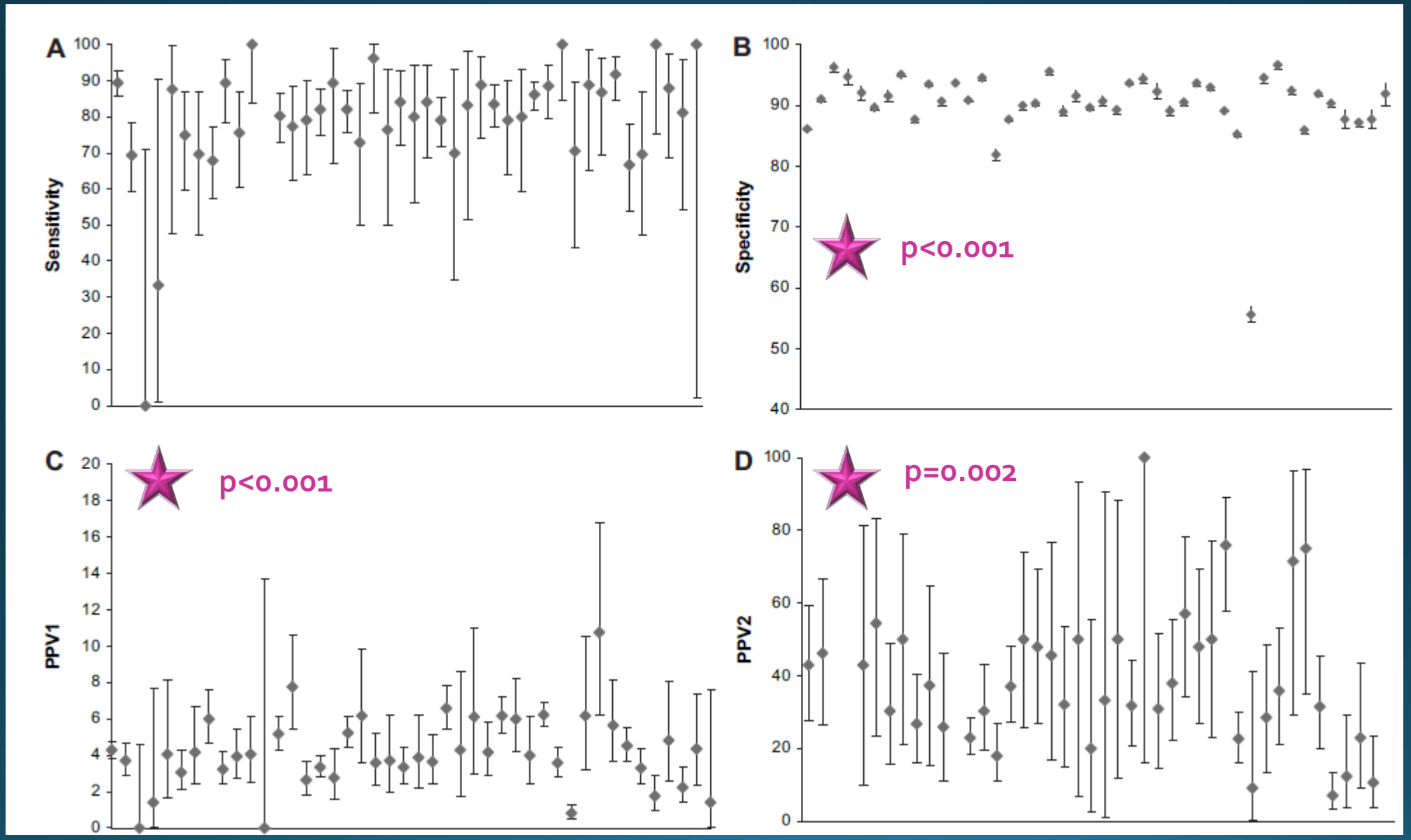
Lee et al. Acad Rad 2014

Geographic Distribution of Breast Screening Services

- Geographic access does not limit mammography
- May limit other breast services
- Facility-level variation in breast services
- Geographic access may drive utilization of particular facilities

How does all of this impact quality?

Geographic Distribution of Quality --- Facility-Level



Taplin et al. JNCI 2008

Facility-Level Quality – Screening Mammography Performance

Screening mammography at facilities serving vulnerable Populations

N_w = 750,857 women
N_f = 151 facilities

Sensitivity the same

Specificity significantly higher for facilities serving vulnerable

Population Vulnerability Index	N	%	Sensitivity	Specificity
No. facilities	151		80.9	91.2
Education				
Nonvulnerable	136	90.1	81.0	90.9
Vulnerable	15	9.9	80.4	93.9
Race/ethnicity				
Nonvulnerable	129	85.4	81.3	90.9
Vulnerable	22	14.6	77.4	93.7
Rural/urban residence				
Nonvulnerable	130	86.1	80.1	91.1
Vulnerable	21	13.9	82.6	92.4
Income				
Nonvulnerable	125	82.8	81.2	90.9
Vulnerable	26	17.2	79.0	93.9
Composite index				
0	106	70.2	81.6	90.4
1	20	13.2	77.9	93.0
2	16	10.6	79.6	93.6
3	4	2.6	83.1	94.2
4	5	3.3	82.8	94.4

Goldman et al. Medical Care; 2008

Facility-Level Quality – Diagnostic Mammography Performance

Diagnostic mammography at facilities serving vulnerable Populations

N_m = 168,251 diag. mammograms
N_f = 153 facilities

Diagnostic mammos to evaluate a breast problem had higher FP rates at facilities serving vulnerable women

	Evaluation of Breast Problem				
	N	%	Sensitivity (%)	False Positive Rate (%)	CDR (per 1000 Examinations)
No. facilities	176				
Education					
Nonvulnerable	134	75.7	84.5	6.3	37.0
Vulnerable	42	23.7	82.5	8.0	36.9
Race/ethnicity					
Nonvulnerable	146	82.5	84.4	6.4	36.9
Vulnerable	30	16.9	82.5	7.7	37.6
Rural/urban residence					
Nonvulnerable	119	67.2	83.9	5.9	34.9
Vulnerable	57	32.2	84.9	8.5	43.5
Income					
Nonvulnerable	115	65.0	84.7	6.4	36.2
Vulnerable	61	34.5	82.7	7.1	39.7
Composite vulnerability score*					
0	77	43.5	84.7	5.7	35.2
1	44	24.9	83.7	8.0	39.6
2	26	14.7	83.9	7.8	39.8
3	22	12.4	81.8	7.7	38.9
4	7	4.0	88.5	8.6	48.4

Goldman et al. Medical Care; 2011

Facility-Level Quality – Mammography Performance; cancer outcomes

Facility characteristics and breast cancer screening outcomes:

- Serving vulnerable populations
- Mammography volume

N_m = 3,098,481 mammograms
N_f = 116 facilities

Facility vulnerability status	Invasive Overall tumor prognosis** Good OR	95% CI	Not good OR	95% CI
Composite index				
1 (least vulnerable)	0.83	(0.73, 0.95)	0.86	(0.76, 0.98)
2	0.92	(0.77, 1.09)	0.99	(0.82, 1.18)
3	0.91	(0.72, 1.15)	1.00	(0.80, 1.25)
4 (most vulnerable)	0.73	(0.58, 0.93)	1.31	(1.05, 1.63)
	p = 0.019		p = 0.001	

Fewer "good", more "poor": Higher vulnerability popul.

More "good", fewer "poor": Higher volume

Interpretative volume of facility at which screening mammogram was interpreted	Invasive Overall tumor prognosis** Good OR	95% CI	Not good OR	95% CI
Annual total volume				
(480, 1000]	0.74	(0.50, 1.09)	0.85	(0.55, 1.31)
(1000, 2000]	1.00	REF	1.00	REF
(2000, 5000]	1.23	(1.03, 1.47)	0.82	(0.67, 1.01)
(5000, 10000]	1.32	(1.09, 1.59)	0.79	(0.64, 0.99)
10000+	1.30	(1.08, 1.57)	0.74	(0.59, 0.93)
	p-for-trend < 0.001		p-for-trend = 0.205	

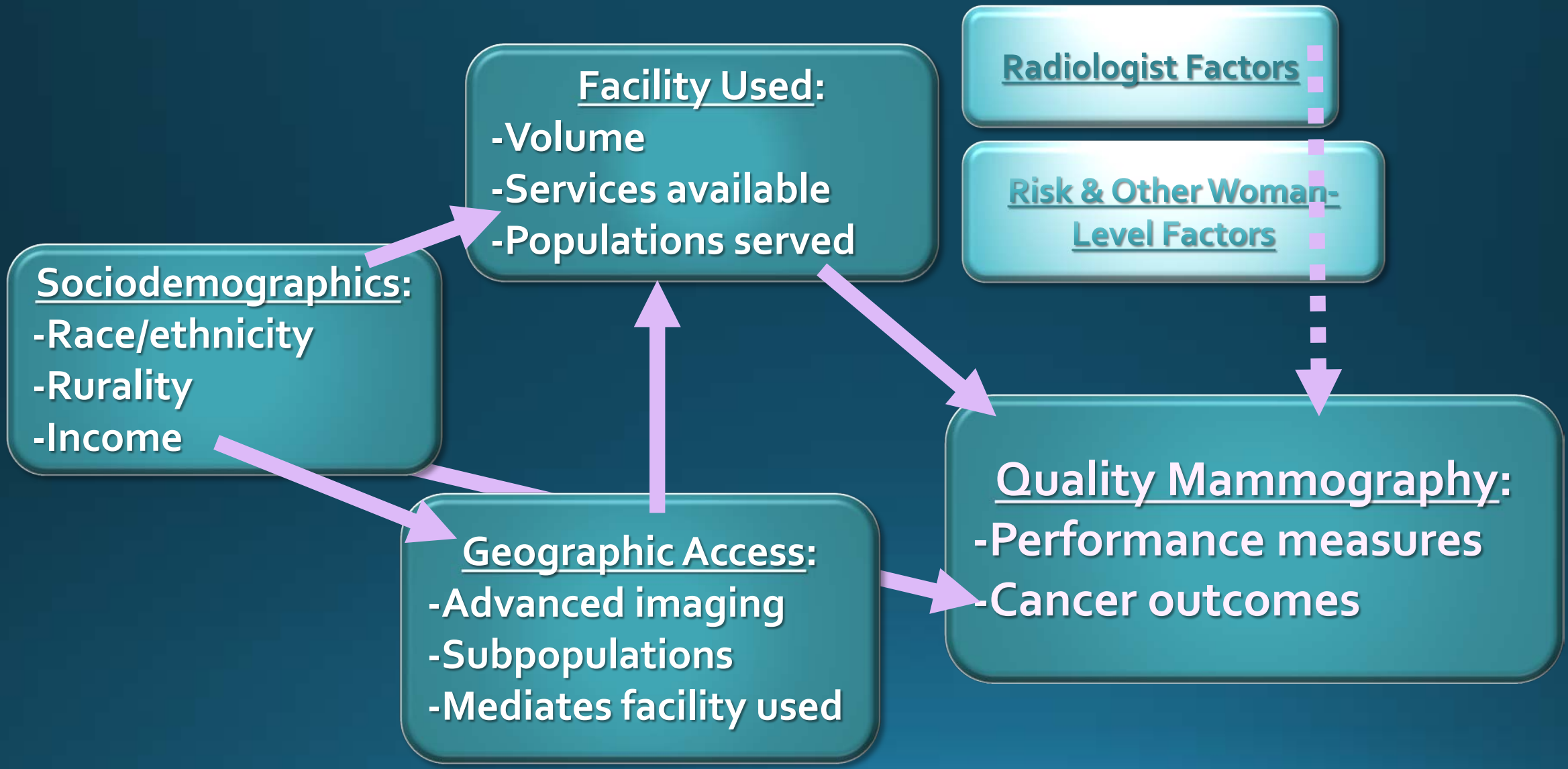
Goldman et al. in press
Onega et al. in press

Synthesizing the Geographic Evidence

- **Variation by geography**
  - Mammography access (spatial) is largely good
  - Utilization varies by sociodemog, but not related to geog. access
  - Outcomes likely mediated by facility (and radiolog.) and woman-level factors

- **Quality variation** at the facility level
  - Mammography performance
    - Screening: signfic. variability, no sociodemog. disparities observed
    - Diagnostic: more FP for women of color
  - Screening outcomes
    - More poor prognosis tumors at vulnerable facilities
    - More good prognosis tumors at high volume facilities

Geographic Distribution of Mammography



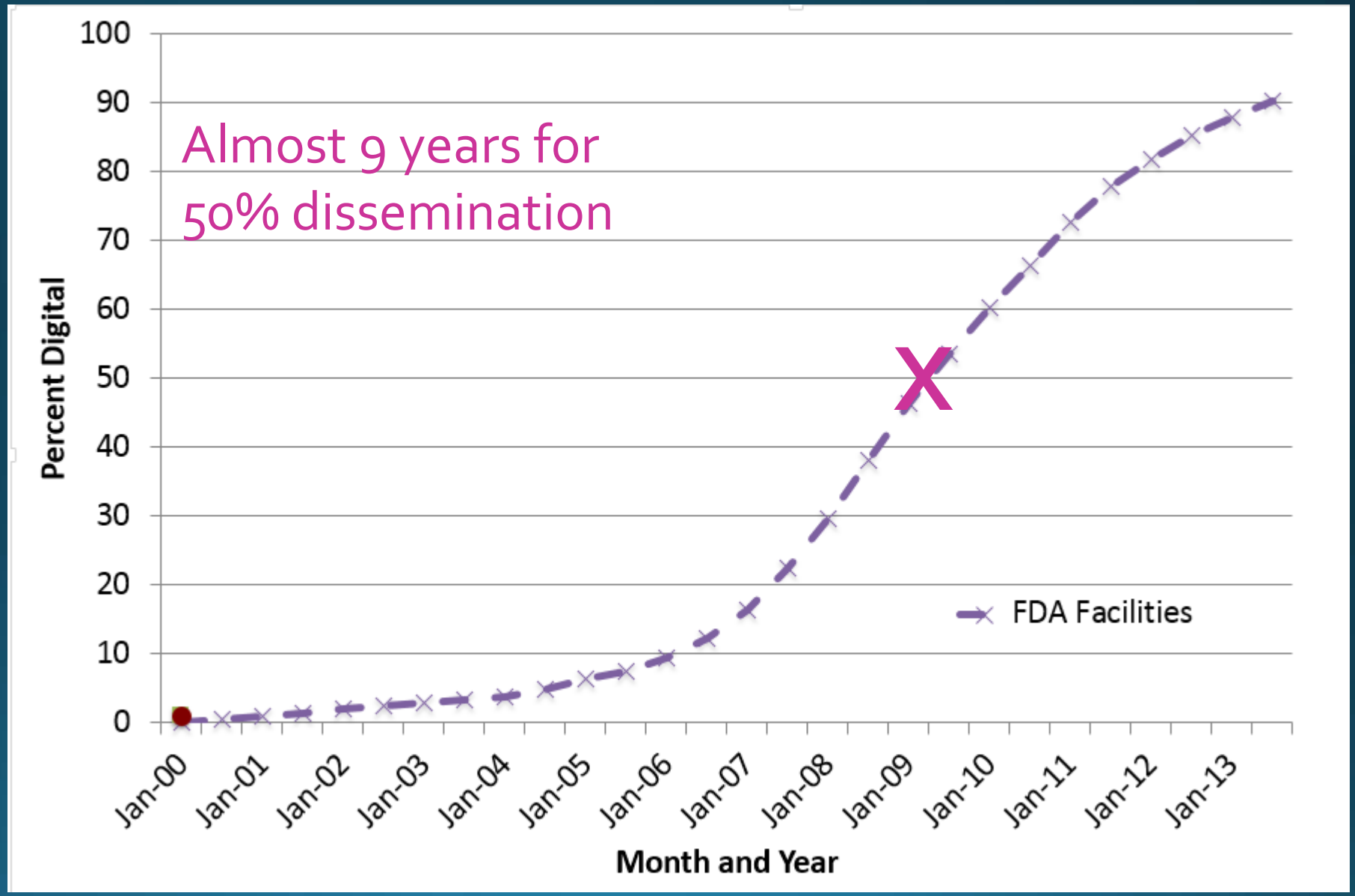
Geographic Access and Equity Concerns

- Diffusion of new technologies is uneven
- Can quality and mammo distribution both be maximized?

Diffusion of Breast Imaging Technology

Uptake of Digital Mammography (2000-2013)

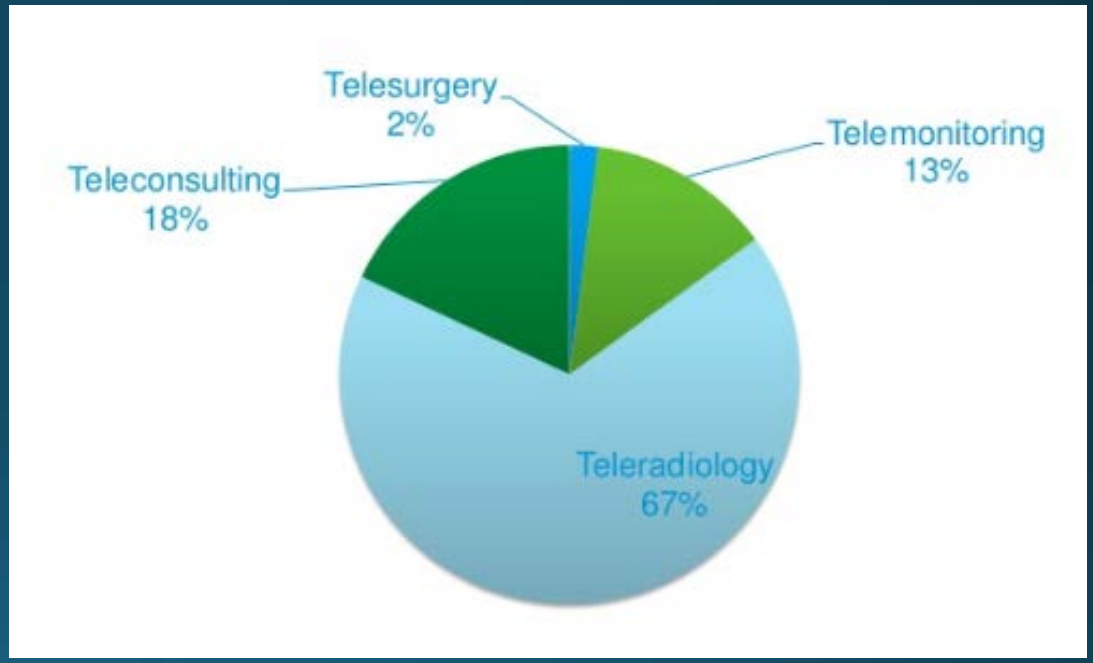
- Evidence shows lags for breast MRI too
- Tracks geographically with markets
- Can widen disparities when effective use lags



Optimizing Distribution of Quality Mammography

Teleradiology: can it even the balance?

- Geographic access would emphasize machines and technicians
- Interpretation would be decoupled from physical location
- Readers could maintain volume thresholds
- Need to examine if volume-outcome relationship holds in this setting
- May help mitigate advanced imaging variation



Teleradiology is the majority of the telemedicine market (67%)

Conclusions

- Geographic access to mammography limits Native American rural women, but otherwise fairly accessible
- Utilization of mammography overall doesn't strongly relate to geographic access, but utilization of quality mammo might
- Geographic access influences facility use and servicess
- Facilities vary significantly in quality
- Some variation in mammo outcomes seen by race/ethnicity
- Facility characteristics such as volume impact outcomes
- Technology diffusion may exacerbate the access/equity pathway
- Telemedicine may offer some mitigation

Thank You!

Breast Cancer Surveillance Consortium

BCSC

Working together to advance breast cancer research

American Cancer Society

National Cancer Institute

INSTITUTE OF MEDICINE

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- Extra slides to follow – not included in presentation