

Interpretive Volume and Screening Accuracy

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Cancer Screening Program

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www.inspq.qc.ca

Overview

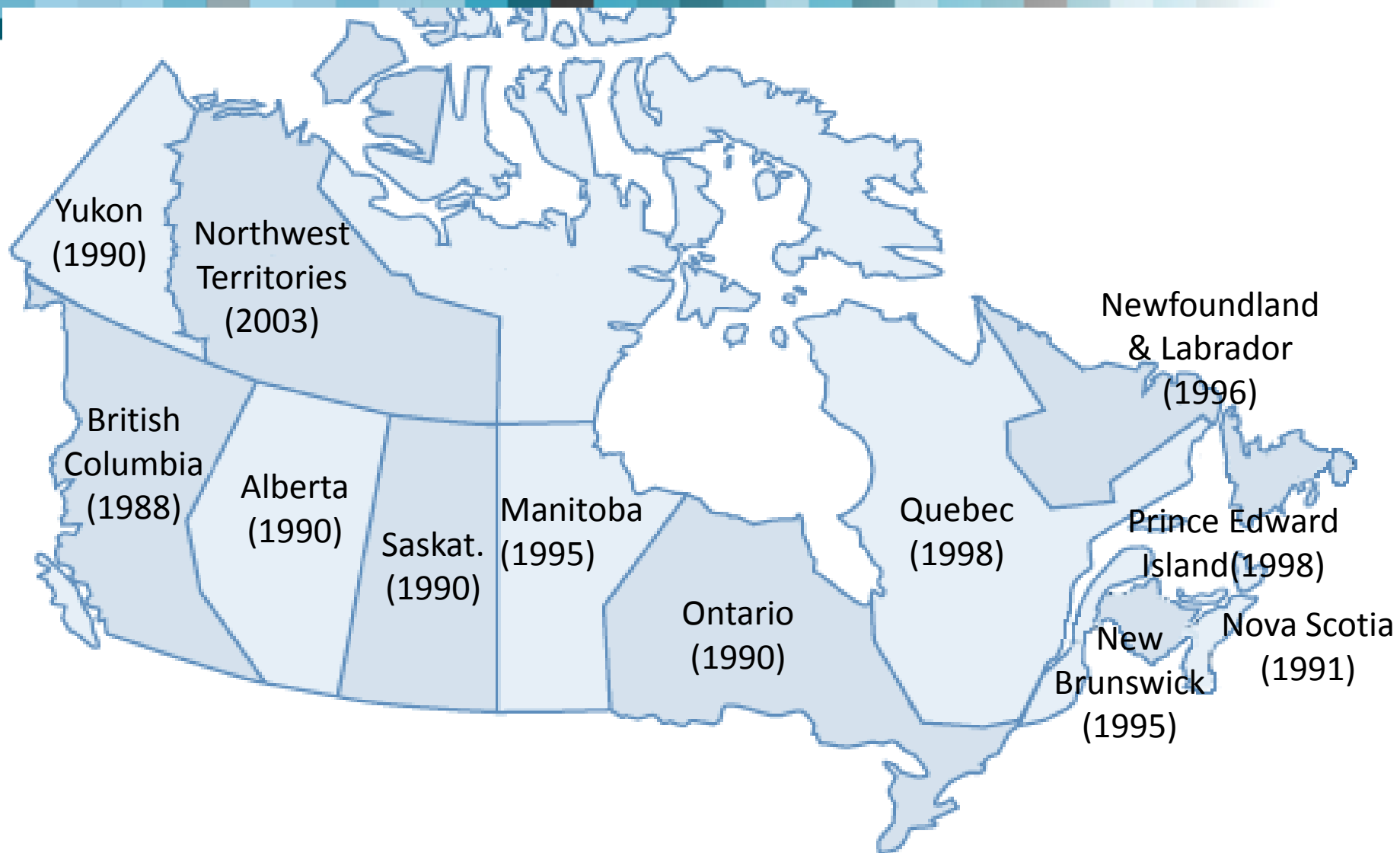


- Breast cancer screening program and requirements volume in Canada
- Association between radiologist interpretive volume and screening accuracy: Study of the Quebec Breast Cancer Screening Program

Requirements volume in Canada

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Breast Cancer Screening Across Canada



Quebec Breast Cancer Screening Program

- Established in 1998
- Offers a bilateral mammogram every 2 years for women aged 50 to 69 years
- About 340,000 screening mammograms in 2013, ~ 100 designated screening centers, ~ 300 radiologists
- Information system where women risk factors are collected

Specific volume requirements for radiologists (february 2015)

	/ year
Nortwest Territories	480
British Columbia	2,500
Alberta	480
Saskatchewan	1,000
Manitoba	1,000
Ontario	1,000
Quebec	750
New Brunswick	1,200
Nova Scotia	2,000
Newfoundland & Labrador	2,000

98-2014: 480 / year
2015 : 750 / year
2016 : 1,000 / year

Cancerview.ca. Breast Cancer Screening Guidelines Across Canada: Environmental Scan. Toronto: Canadian Partnership Against Cancer; [2015].

Mammography screening objectives

Reduce
breast cancer
mortality



Minimize
adverse
effects

Accuracy components – Reduction of mortality

		Breast cancer		Total
		+	-	
Screening Episod	+	a	b	N_1
	-	c	d	N_0
Total		M_1	M_0	T

$$\text{Sensitivity (1 year)} = \frac{a}{M_1}$$

$$\text{Detection rate} = \frac{a}{T} \quad \leftarrow \text{Prevalence of breast cancer}$$

Accuracy components – Minimize adverse effects

		Breast cancer		Total
		+	-	
Screening Episod	+	a	b	N_1
	-	c	d	N_0
Total		M_1	M_0	T

$$\text{False-positive rate} = \frac{b}{M_0}$$

$$\text{Recall rate} = \frac{N_1}{T}$$

Accuracy components

		Breast cancer		Total
		+	-	
Screening Episod	+	a	b	N_1
	-	c	d	N_0
Total		M_1	M_0	T

Positive likelihood ratio = $\frac{\text{Sensitivity}}{\text{False-positive rate}} = \frac{a / M_1}{b / M_0}$

PPV = $\frac{\text{Detection rate}}{\text{Recall rate}} = \frac{a}{N_1}$ ← Prevalence of breast cancer

Study of the Quebec breast cancer screening program

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Study objectives

Sensitivity

Radiologist
interpretive
volume

False-Positive
Rate

Positive Likelihood Ratio
(Sensitivity / False-Positive Rate)

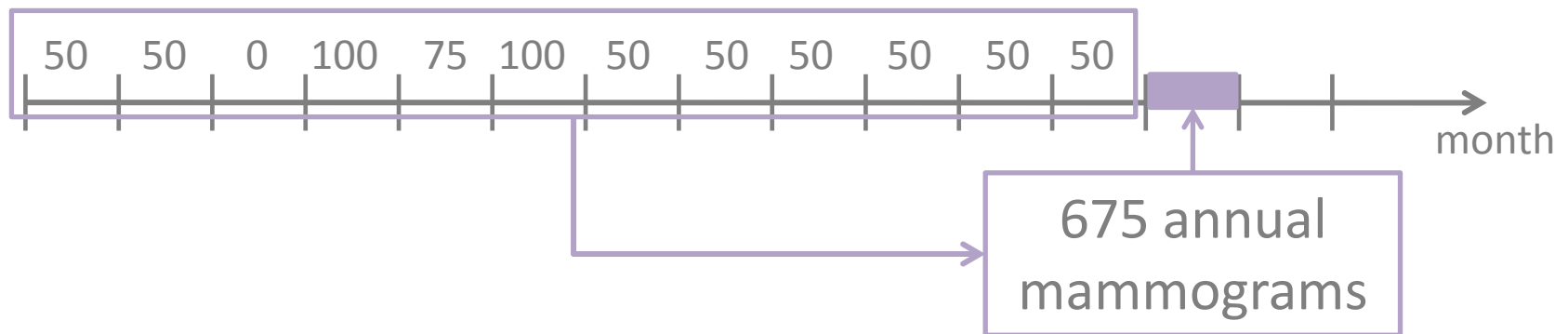
Study population



- 91 % of all screening mammograms in the program between 2000 and 2006 (n = 1,315,327)
- All radiologists participating in the program (n = 340)

Measurement of annual volume

- Total, screening and diagnostic volume obtained from physicians' claims database
- Annual volume in the previous 12 months, calculated for each month



Potential confounders

Women

Age

Breast density

Body-mass index

Family history of breast cancer

Menopause status

Full term pregnancy

Hormone replacement therapy

Breast aspiration or biopsy

Screening history
(time since last mammogram)

Radiologists

Year of graduation

Gender

Medical school
attended

Facilities

Public or private

Annual volume of
mammograms

Accuracy components

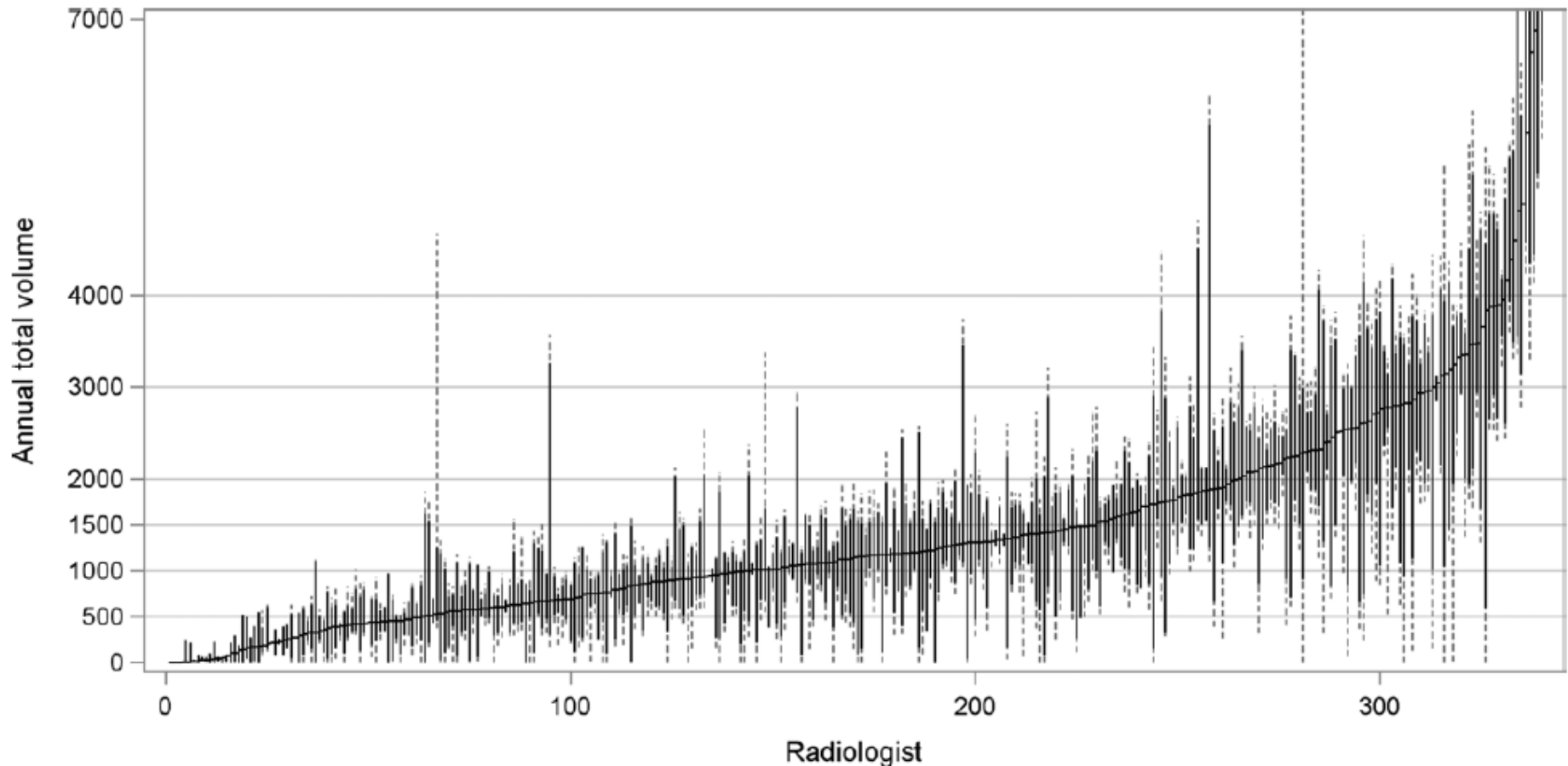
		Breast cancer		Total
		+	-	
Screening Episod	+	6,860	122,267	129,127
	-	1,055	1,185,145	1,186,200
Total		7,915	1,307,412	1,315,327

$$\text{Sensitivity (1 year)} = \frac{6,860}{7,915} = 86.7 \%$$

$$\text{False-positive rate} = \frac{122,267}{1,307,412} = 9.4 \%$$

$$\text{Positive likelihood ratio} = \frac{86.7 \%}{9.4 \%} = 9.3$$

Variability of total annual volume for the 340 radiologists, 2000-2006



Curve line: median, Solid line: range between 10th and 90th percentiles, Dotted line: range of all volume values of total volume for each radiologist

Minimum requirement

Annual total volume

Always < 500



29 radiologists (8%)

Sometimes < 500,
Sometimes \geq 500



152 radiologists (45%)

Always \geq 500



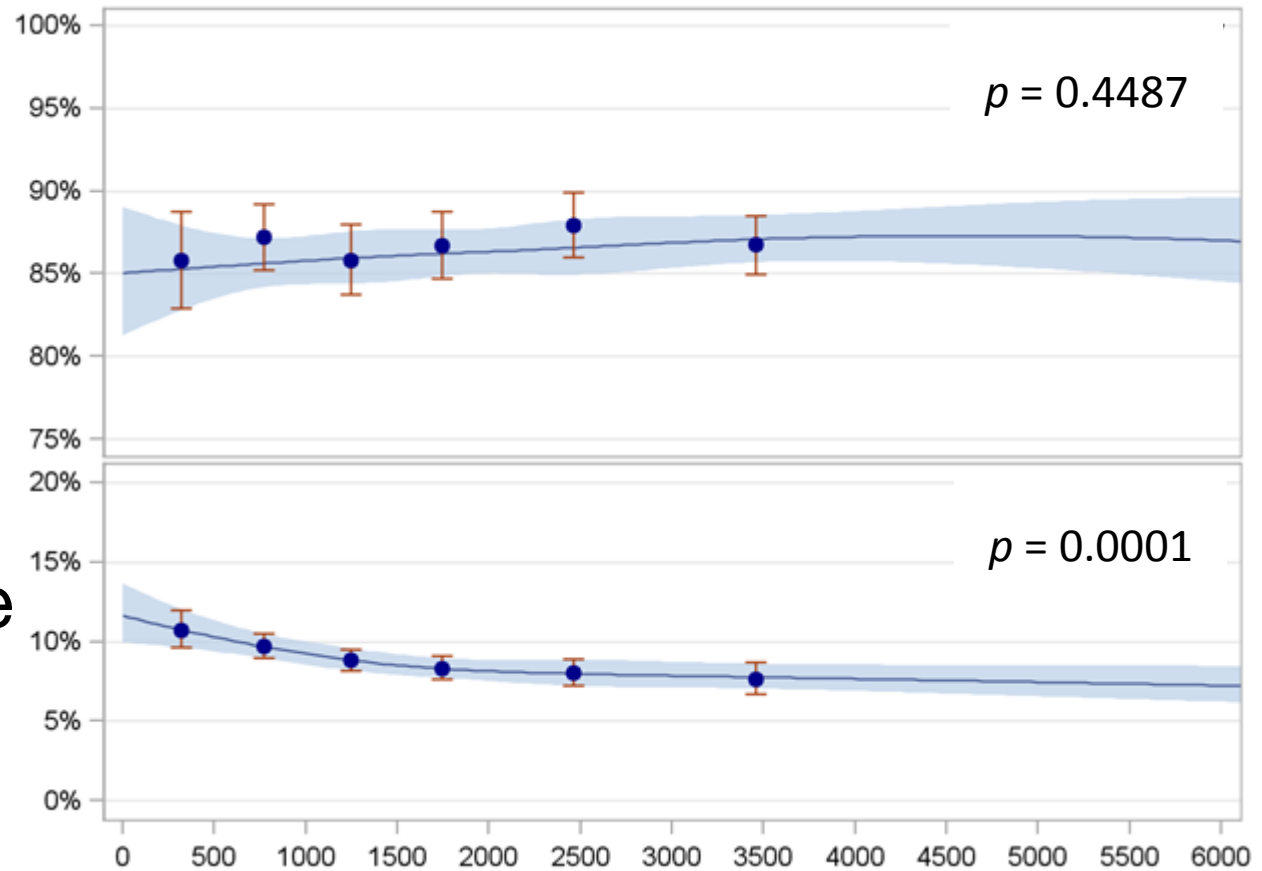
159 radiologists (47 %)

Minimum requirement

Annual total volume	Sensitivity Adj. Ratio (95 % CI)	False-Positive Rate Adj. Ratio (95 % CI)
Always < 500	0.80 (0.66-0.98)	1.91 (1.20-3.04)
Sometimes < 500, Sometimes ≥ 500	1.01 (0.99-1.03)	1.17 (1.03-1.32)
Always ≥ 500	1.00	1.00

Total volume and accuracy components

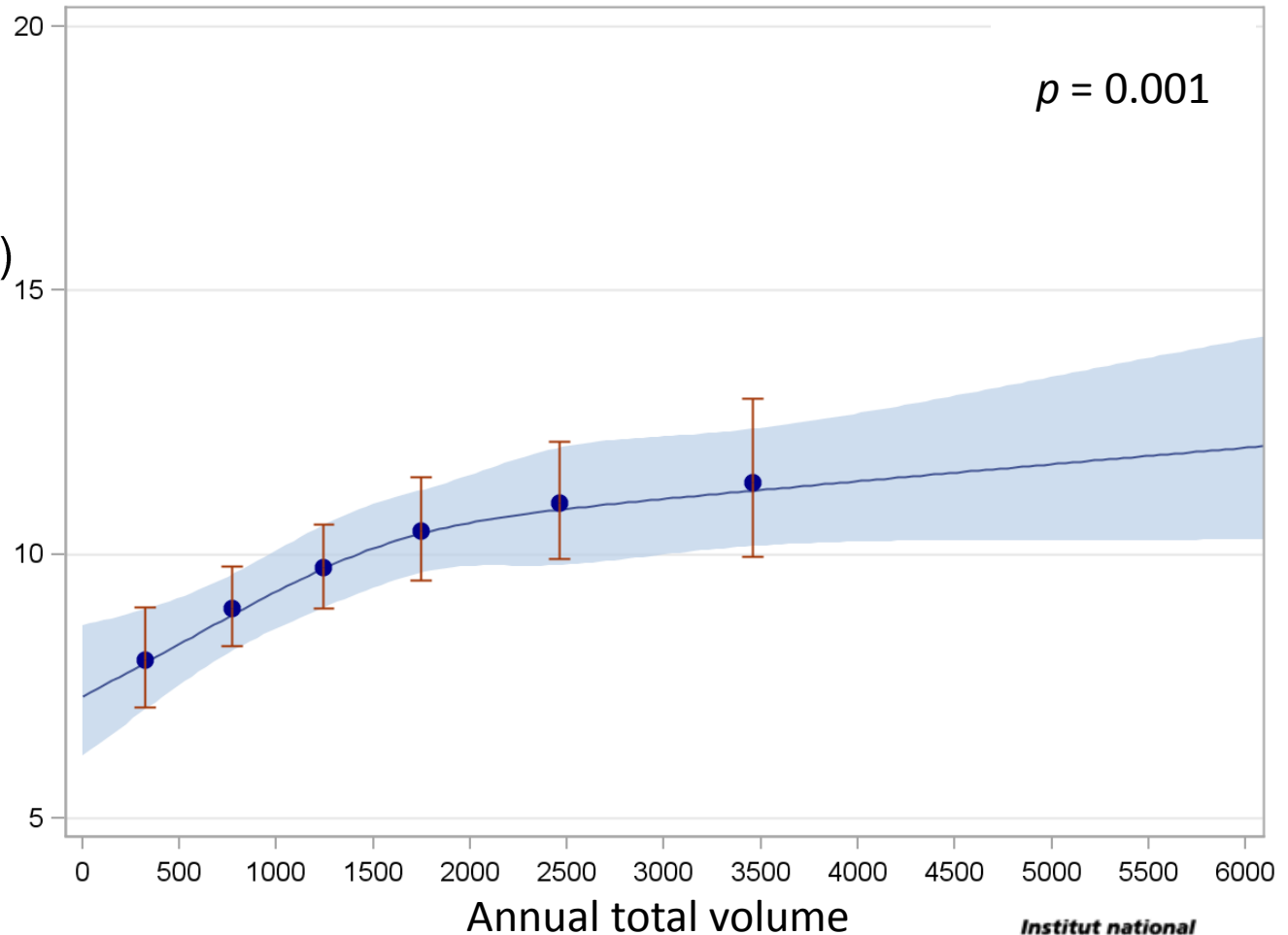
Sensitivity



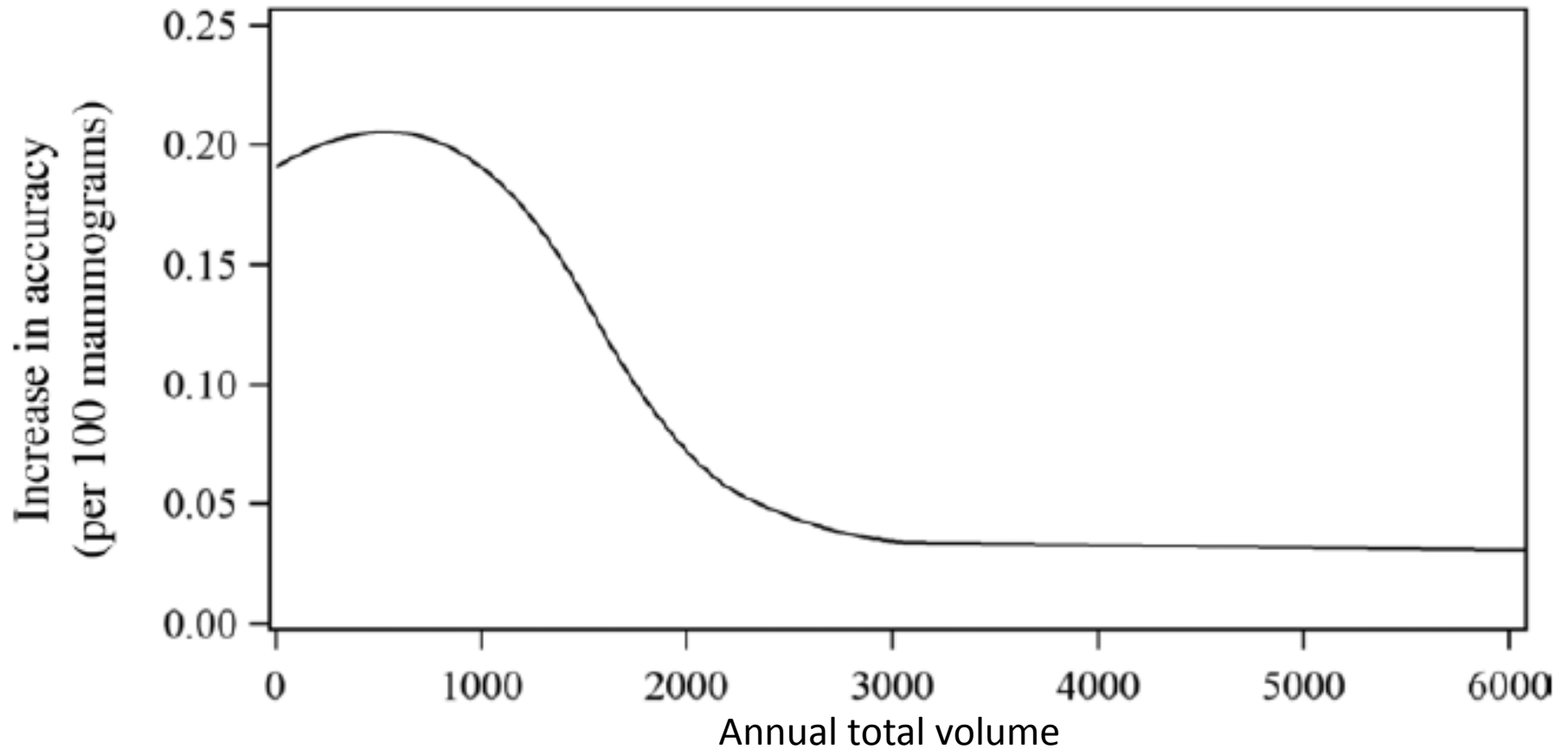
False-positive rate

Total volume and screening accuracy

Accuracy
(Sensitivity /
False-positive rate)



Increase in accuracy by total volume



Summary



- Radiologist volume requirements vary from program to program across Canada
- Minimal volume requirement of 500 mammograms annually is justified
- Raising the volume of radiologists may help to minimize false-positive rate without change in sensitivity
- Potential gains in accuracy with increases in volume may be greater up to an annual volume of approximately 3,000 mammograms

Thank you !

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