Evaluation of the performance of designated screening centers of the Programme Québécois de Dépistage du Cancer du Sein (PQDCS)

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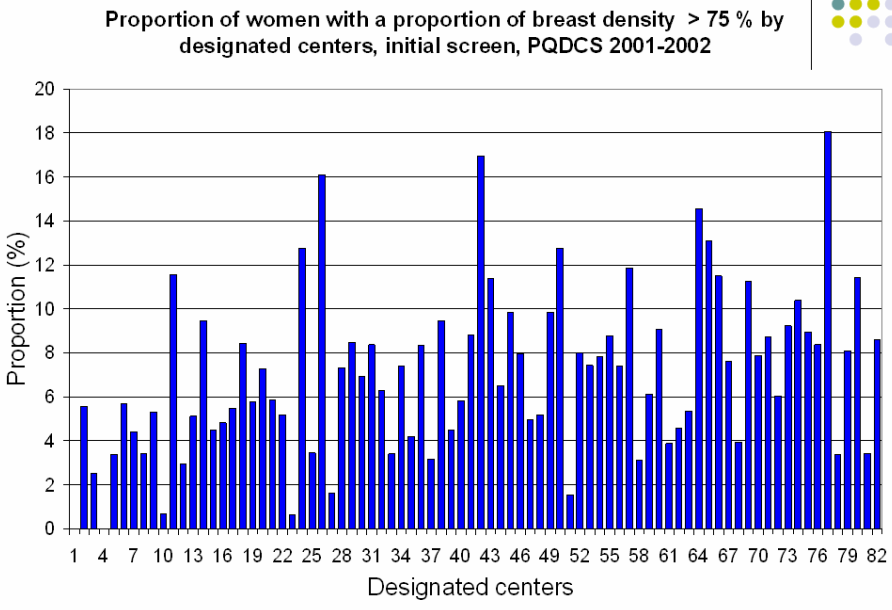
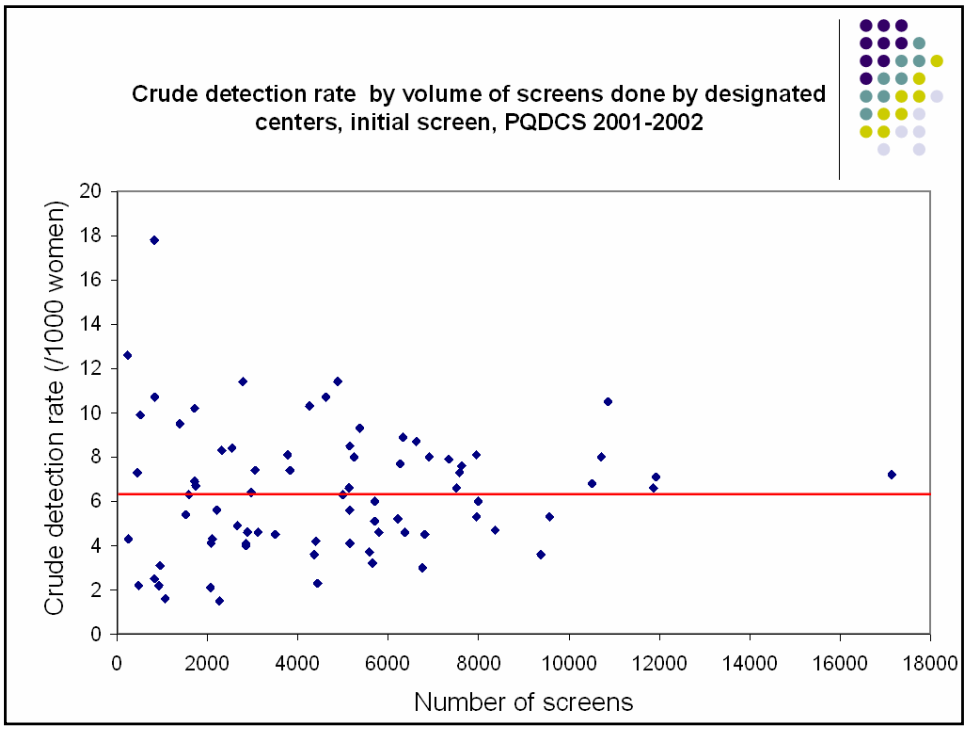
Introduction

With 22,300 new cases estimated for 2007, breast cancer is the most common cancer in Canadian women. Organized breast cancer screening program began in Canada (BC) in 1988. In Quebec, the Programme Québécois de Dépistage du Cancer du Sein (PQDCS) started in may 1998. The PQDCS invites every woman aged 50 to 69 to have a mammography each two years. More than 250 000 screening mammographies were done in the PQDCS in 2006. Evaluation of the PQDCS is mainly based on the analysis of performance indicators as defined in the program guidelines. Performance indicators were initially measured to monitor the performance of the program at the provincial and regional levels.

Context

- Characteristics of women coming for screening mammography can vary from one screening center to another; some centers screen relatively few women annually
- Variation in characteristics (case-mix) can lead to bias when comparing different centers; adjustment for the case-mix is needed
- Small number of women screened can lead to much statistical variation in estimates of performance indicators; confidence intervals can reflect such random variation





Objectives

- To develop a method for calculating performance indicators at the level of screening centers adjusting for case-mix
- To develop a method to calculate confidence intervals for adjusted indicators
- To apply the developed methods, examine changes in performance of centers over time and compare performance of centers with provincial mean and program targets

Outcomes

Performance indicators	Definitions
Recall rate	Number of abnormal screens / Number of screens X 100
Detection rate	Number of screen detected cancers / Number of screens X 1 000
Number of false positive per screen detected cancer	Number de false positive screens / Number of screen detected cancers
In situ cancer detection rate	Number of *in situ* cancers / Number of screen detected cancers X 100
Invasive cancer tumour size	Number of invasive cancers ≤ 1 cm / Total number of invasive cancers X 100
Node negative rate in cases of invasive cancer	Number of invasive cancer with negative lymph nodes / Total number of invasive cancers in which lymph nodes were assessed X 100

Methods

The performance of each center is compared to the performance achieved by the entire program and to provincial standards. The indirect standardization method has been chosen to adjust for case-mix. This method generates a ratio of an observed rate in a given center to an expected rate in this center had the performance been similar to that seen in the entire province. A normal approximation based on a log-transformation of the ratio (obs/exp) is used to calculate the confidence intervals.

To illustrate this method, we will apply it to one fictional center. This example is done with the detection rate (DR).

Center A

Province

5.0 cancers / 1,000 women

Worse performance ?

6.5 cancers / 1,000 women

- 8% 65-69 years
- 10% of family history
- 5% no previous screen

- 12% 65-69 years
- 14% of family history
- 15% no previous screen

Observed rate

If **Center A** found 10 cancers in 2,000 women, their observed detection rate is 5.0 cancers /1,000 women.

Expected rate

Calculation of the expected detection rate is based on the results of a logistic regression model that includes characteristics of women and is carried-out among all those who were screened in the PQDCS. The PQDCS detection rate can be calculated by the logistic model:

$$\pi(x) = \frac{e^{\alpha+\beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_p X_p}}{1 + e^{\alpha+\beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_p X_p}}$$

For example, if we have only two characteristics (age and family history) in our model, we can calculate, for each woman screened in center A, her expected detection rate according to PQDCS detection rates. Then, the expected detection rate for **Center A** is the mean of these individual expected rates.

Age	Family history	Expected DR (/ 1000 women)
50-54	no	4,88
55-59	no	6,78
60-64	no	7,26
65-69	no	7,40
50-54	yes	7,16
55-59	yes	9,93
60-64	yes	10,63
65-69	yes	12,30

Center A	Characteristics of women	Expected DR (/ 1000 women)
1st woman	Age 52, no family history	4,88
2nd woman	Age 60, with family history	10,63
3rd woman	Age 61, no family history	7,26
…	…	…

$$\text{The expected detection rate for Center A} = \frac{\text{Sum of each woman's expected DR}}{\text{2,000 women}} = \frac{13.72}{2{,}000} = \text{6.9 cancers /1,000 women}$$

Adjusted rate

$$\frac{\text{Observed rate}}{\text{Expected rate}} \times \text{Provincial rate} = \text{Adjusted rate}$$

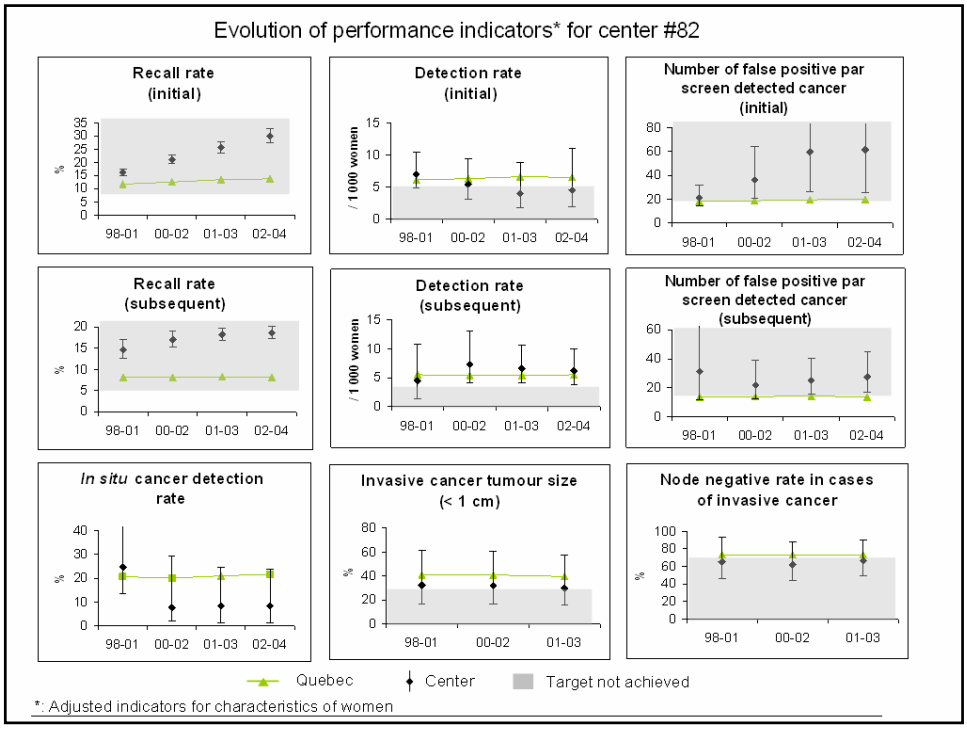
$$\text{The adjusted detection rate for Center A} \quad \frac{5.0 / 1{,}000}{6.9 / 1{,}000} \times 6.5 / 1{,}000 = 4.7 / 1000$$

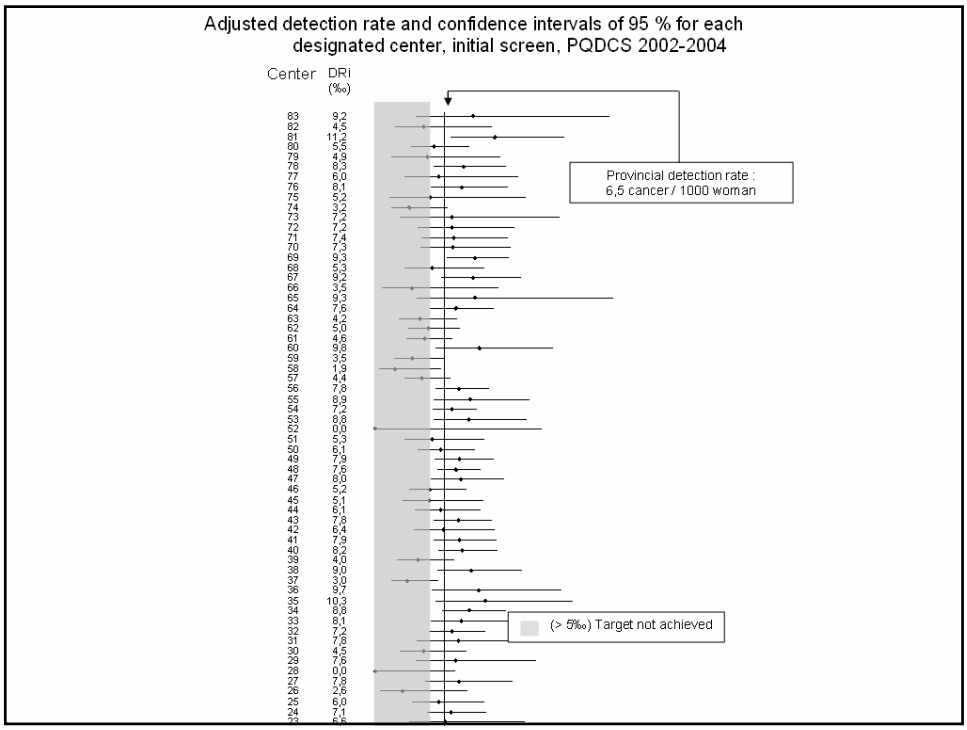
Confidence intervals

$$I.C.95\%\ du\ ratio = \frac{taux\ observé}{taux\ attendu} * e^{\left(\pm Z_{\alpha/2}\sqrt{\frac{n-x}{nx} + \frac{\hat{Var}(A)}{\hat{A}^2}}\right)}$$

Applications

- The first graph presents the trends over time of nine different indicators of performance for one center. This approach is used to give an overview of the entire performance of one particular center. In this graph, it is possible to compare the performance of the center with that of the PQDCS and with the target for each indicator.
- The second graph compares, for a period of three years and for one indicator, the performance of each center compared with the PQDCS and the target of the indicator.





Lessons learned and implications

- The graphs were sent to each radiologist for centers where they worked. Comments from radiologists were generally quite good.
- The Health Ministry (MSSS), Quebec association of radiologists (ARQ) and Quebec Public Health Institute (INSPQ) met to analyse center performance, identify centers in need of support and consider possible means of improving performance when needed. The detection rate at initial screen was the key indicator in need of improvement.
- Two centers have been visited by expert radiologists to help analyze current practice and find avenues for improving performance.
- These methods could also be used to evaluate the performance of centers involved in the investigation of women with abnormal mammograms.