

Double reading of mammograms in breast cancer screening: costs and potential overdiagnosis

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Objectives

The usual practice in European breast cancer screening programmes for mammogram interpretation is to perform double reading. However, the relation between double reading and overdiagnosis, and its economic consequences have not been evaluated thoroughly. Our purpose was to assess the costs and health-related outcomes of double reading versus single reading of digital mammograms in a breast cancer screening programme.

Method

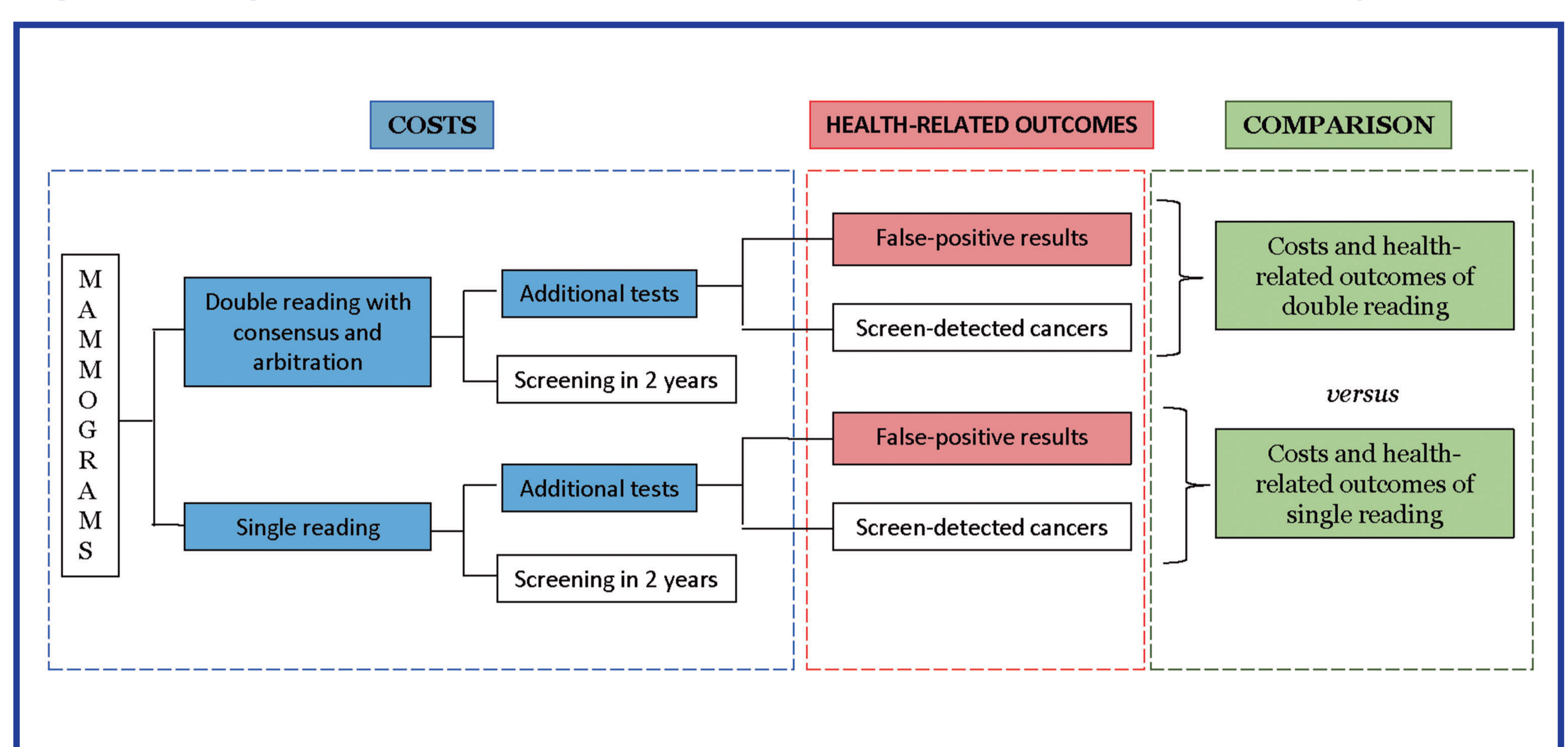
We used data from 57,157 digital mammograms performed from June 2009 to May 2013 in women aged 50–69 years participating in the breast cancer screening programme of the Hospital Sant Pau, Barcelona, Spain.

Mammograms were read by four highly trained radiologists. We compared costs, false-positive results, cancer detection rate, and proportion of ductal carcinoma in situ, of double reading with consensus and arbitration versus single reading.

Table 1. Characteristics of study population by screening round

Population	Round 2009-2011		Round 2011-2013	
	N	%	N	%
Invited women	48,803	100.0	46,819	100.0
Attendance	28,636	58.7	28,521	60.9
Prevalent screening	5,978	20.9	5,375	18.8
Incident screening	22,658	79.1	23,146	81.2
Age				
Mean (SD)	59.0	(5.9)	59.5	(5.7)
50-54	8,181	28.6	7,913	27.7
55-59	6,947	24.3	7,244	25.4
60-64	7,047	24.6	7,031	24.7
65-69	6,461	22.6	6,333	22.2

Figure 1. Algorithm followed to perform the cost-consequence analysis



Results

Double reading with consensus and arbitration (€ 2,571,867) was 15% (€ 334,341) more expensive than single reading (€ 2,237,527).

Table 2. Unit and total costs (Euro) stratified by reading strategy

Screening costs	Unitary cost	Single reading		Double reading	
		N	Cost.	N	Cost.
Mammogram	€ 5.6	57,157	€ 322,770.0	57,157	€ 322,770.0
Staff	NA	NA	€ 1,408,651.9	NA	€ 1,433,561.5
Readers	€ 3.5	57,157	€ 199,061.8	114,314	€ 398,123.7
Consensus	€ 6.9	0	0.0	2,508	€ 17,469.3
Arbitration	€ 10.5	0	0.0	48	€ 501.5
Additional tests					
Women underwent additional tests	NA	2,617	NA	2,822	NA
Additional mammograms	€ 32.7	1,295	€ 42,307.7	1,473	€ 48,122.9
Ultrasounds	€ 50.1	1,928	€ 96,669.9	2,59	€ 129,862.6
Fine needle aspiration	€ 141.8	507	€ 71,902.7	605	€ 85,801.1
Core biopsy	€ 131.7	322	€ 42,429.9	449	€ 59,164.7
Surgical biopsy	€ 1,536.0	14	€ 21,504.0	20	€ 30,720.0
Others	€ 194.9	163	€ 31,759.7	232	€ 45,204.0
Imputed costs	NA	2	€ 468.8	4	€ 565.8
Total cost			€ 2,237,526.5		€ 2,571,867.1

False-positive results were more frequent at double reading with consensus and arbitration than at single reading [4.5% (N= 2,559) and 4.2% (N= 2,378), respectively; $p < 0.001$]. The cancer detection rate were similar for both reading strategies [4.6 per 1000 screens (N= 263) and 4.2 per 1000 screens (N= 239), respectively; $p = 0.283$]. The proportion of ductal carcinoma in situ detected by double reading with consensus and arbitration was slightly higher than with single reading [16.2% (N= 42) and 14.9% (N= 35) respectively; $p = 0.776$].

Table 3. Comparison between costs and health related outcomes of double and single reading strategies

	Costs			Health related outcomes (57,157 participants)			
	Double reading	Single reading	Incremental cost	Double reading	Single reading	Incremental effect	p
Mammogram	€ 2,172,426.0	€ 1,930,483.8	€ 241,942.2 (12.5%)	False positives	4.5%	4.2%	0.3% 0.001
Additional tests	€ 399,441.2	€ 307,042.7	€ 92,398.4 (30.1%)	Positive predictive value	9.3%	9.1%	0.2% 0.812
Total Cost	€ 2,571,867.1	€ 2,237,526.5	€ 334,340.6 (15.0%)	Number of women with additional tests	2,822	2,617	205 0.004
				Cancer detection rate	4.6‰	4.2‰	0.4‰ 0.283

Conclusion

Our results suggest that changing to single reading of mammograms could produce health benefits and savings in breast cancer screening. Single reading could also reduce the frequency of false positive results without significantly changing the cancer detection rate. Double reading has classically been considered beneficial because it detects more cancers than single reading, but it may increase the detection of ductal carcinoma in situ, carrying a potential risk of overdiagnosis. Further prospective long-term studies such as cost-effectiveness analyses and randomized controlled trials are needed to evaluate the relation between overdiagnosis and reading strategies in breast cancer screening programmes.

References

Posso M, Puig T, Quintana MJ, Solà-Roca J, Bonfill X. Double versus single reading of mammograms in a breast cancer screening programme: a cost-consequence analysis. Eur Radiol. 2016 Sep; 26(9): 3262-71.