Can an Artificial Intelligence System (AIS) help human readers in a Digital Mammography (DM) Breast Screening Program (BSP)? Our preliminary experience.

REGIONE DEL VENETO

ULSS2 MARCA TREVIGIANA

CENTRO SENOLOGICO TREVIGIANO

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Introductions

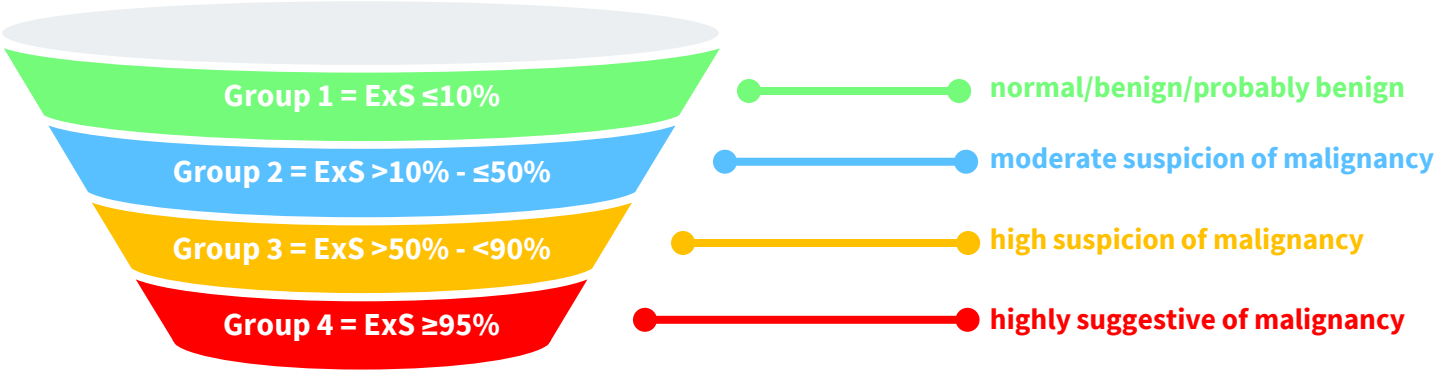
- Artificial Intelligence Systems (AISs) **can have an impact** on the management of a Breast Cancer Screening Program (BSP)
- Our study aims to analyze our preliminary **real-world data** of **AIS-aided Human Blinded Double Reading** (HBDR), standard practice in Italy, in a Digital Mammography (DM) population-based BSP, in terms of:
  - **Detection Rate (DR)**: number of Breast Cancer (BC) per 1000 screens
  - **Recall Rate (RR)**: percentage of women recalled for further evaluation

Methods and Materials

- In the Treviso (Italy) BSP **19310** women **age-group 50-74** (mean age 60.6 yrs) were screened with two-view DM between **November 2021** and **March 2022**
- All images were acquired with DM equipment from **3 different companies** (Fuji, Hologic, and Philips)
- HBDR was used by five **Dedicated Breast Radiologists** (DBRs) with at least two years of experience (mean 10.8 yrs)
- **Arbitration** of discordant readings was applied
- All images were processed by the AIS algorithm *Lunit INSIGHT MMG® v.1.1.6.2*, which automatically detects lesions suspicious of Breast Cancer (BC) and provides the following:
  - **EXAM SCORE** (ExS): overall exam score from 0-100%, which corresponds to the region assigned the highest score
  - **REGION SCORE**: **except for ExS ≤10%**, all suspicious lesions were marked according to the probability of malignancy
- ExS was **visible** to the DBRs during HBDR (= AIS-aided-HBDR)

Methods and Materials

ExS were grouped into four levels of **increasing risk**:



ExS «**cut off**» **>10% as positive** was applied for calculating AIS:

- **Positive Predictive Values (PPV)**
- **Negative Predictive Values (NPV)**
- **Sensitivity (Sn)**
- **Specificity (Sp)**

Results

AIS classified 20.4% of the DMs as positive (ExS>10%), while AIS-aided HBDR recalled patients were 2.3%

	All		G1		G2		G3		G4	
	positive	RR%	positive	RR%	positive	RR%	positive	RR%	positive	RR%
AIS-aided HBDR	447	2.3	77	0.5	149	4.4	150	29.3	71	88.8
AIS positive (>10%)	3942	20.4%								

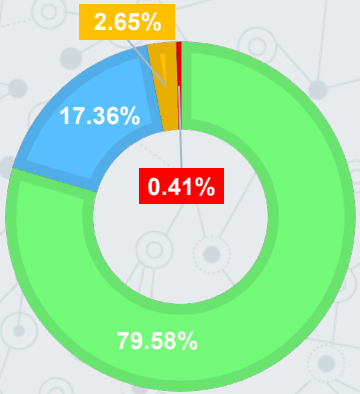
	All		G1		G2		G3		G4	
	BC	DR‰	BC	DR‰	BC	DR‰	BC	DR‰	BC	DR‰
Screen-detected cancers: AIS-aided HBDR	127	6.6	2	0,1	13	3,9	46	89,84	66	825,0
Screen-detected cancers: concordant HBDR	102	5.3								
Screen-detected cancers: AIS positive (>10%)	125	6.5								

- Overall biopsy-proven BCs were 127/127 (DR 6.6‰):
- 80% of the BCs (102/127;DR 5.3‰) were detected by both DBRs (concordand reading)
- 20% of BCs (25/127) were detected only by one of the DBRs (discordant reading)
- AIS correctly identified 98% (125/127;DR 6.5‰) of the BCs

Results

ExS stratification among the four risk groups of the processed DMs

- Group 1: 15359 exams
- Group 2: 3350 exams
- Group 3: 512 exams
- Group 4: 80 exams

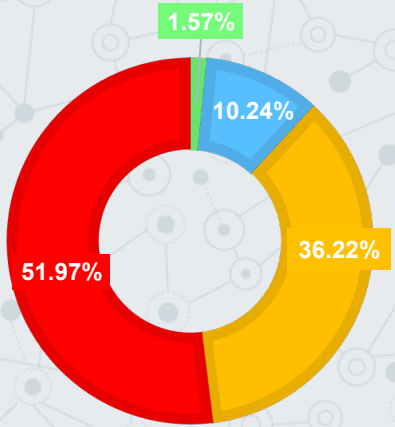


In a subgroup analysis:

65% (12570/19310) of the DMs have ExS ≤5%

The average ExS of the 127 BCs was 84% (range 5.97% - 99.89%) with following distribution:

- Group 1: 2 BC
- Group 2: 13 BC
- Group 3: 46 BC
- Group 4: 66 BC



In a subgroup analysis:

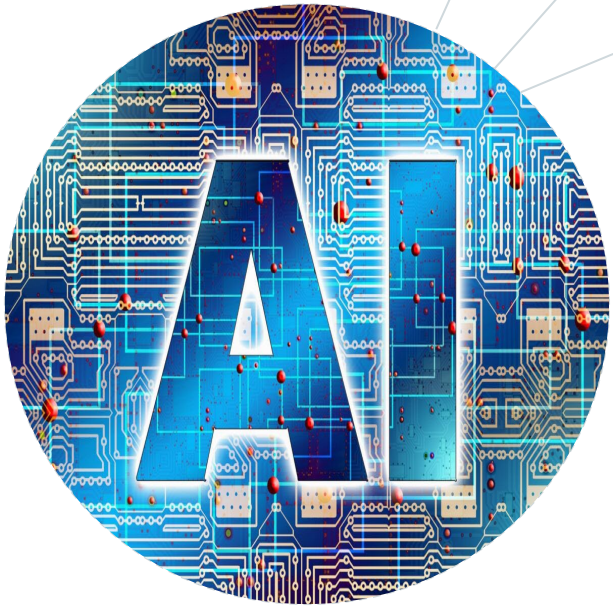
In the 12570 exams with ExS ≤5% no BC was detected

Results: AIS

	Gold Positive	Gold Negative	Total
Test Positive	125	3817	3942
Test Negative	2	15366	15368
Total	127	19183	19310

	Ratios
Sensitivity	98.4 %
Specificity	80.1 %
Accuracy	80.2 %
Prevalence	0.7 %
Positive Predictive Value	3.2 %
Negative Predictive Value	100.0 %
Post-test Disease Probability	3.2 %
Post-test Health Probability	100.0 %
Positive Likelihood Ratio	4.95
Negative Likelihood Ratio	0.0197

The jamovi project (2022). jamovi. (Version 2.3) [Computer Software]. Retrieved from https://www.jamovi.org.



Results: AIS-aided HBDR

	Gold Positive	Gold Negative	Total
Test Positive	127	320	447
Test Negative	0	18863	18863
Total	127	19183	19310

	Ratios
Sensitivity	100.0 %
Specificity	98.3 %
Accuracy	98.3 %
Prevalence	0.7 %
Positive Predictive Value	28.4 %
Negative Predictive Value	100.0 %
Post-test Disease Probability	28.4 %
Post-test Health Probability	100.0 %
Positive Likelihood Ratio	59.9
Negative Likelihood Ratio	0.00

The jamovi project (2022). jamovi. (Version 2.3) [Computer Software]. Retrieved from https://www.jamovi.org.

Discussion

- The **very low AIS PPV** makes it **challenging** to propose a BSP with **only AIS standalone reading**
- Currently, **human reading is essential** to compensate for the very low PPV of AIS, also because readers have the **possibility of comparison with previous mammograms**

- However, the **exceptional NPV (100%)** of AIS in the subset of examinations with **ExS ≤5%** allows us to assume their **automatic pre-selection for single reading** by DBRs, thus significantly **reducing the workload** of the BSP and **maintaining overall sensitivity**

Thanks!

Any questions?

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