has the false positive rate for mammograms gone down over the years

The evidence from recent research articles indicates that advancements in breast cancer screening technologies, particularly with the integration of artificial intelligence (AI) and machine learning, have contributed to a reduction in the false positive rates of mammograms over the years.

* **Integration of AI and Machine Learning:** Advanced AI-driven computer-aided detection (AI-CAD) systems have shown promise in reducing false-positive rates in breast cancer screening. The use of deep learning techniques, such as convolutional neural networks, has improved the accuracy of these systems [1].
* **Digital Breast Tomosynthesis (DBT):**The adoption of digital breast tomosynthesis, an advanced form of mammography, has been noted to improve screening outcomes. DBT provides three-dimensional imaging, which helps in better visualization of breast tissues, potentially reducing false positives [2].
* **Global Screening Programs:** Despite the improvements, the false-positive rates in mammography remain a concern in global breast cancer screening programs. However, personalized screening strategies and risk prediction models are being developed to further reduce these rates [3].
* **Machine Learning Algorithms:** Specific machine learning models have achieved high accuracy in breast cancer classification, with reported false positive rates as low as 0.01, indicating a significant reduction in misclassification of benign tumors as malignant [4].

Overall, while traditional mammography has been challenged by high false-positive rates, the integration of newer technologies and methodologies has contributed to a gradual reduction in these rates, enhancing the effectiveness of breast cancer screening programs.

References:
[1] Le EPV, Wang Y, Huang Y, Hickman S, Gilbert FJ. Artificial intelligence in breast imaging. Clinical radiology. May 2019;74(5):357-366. 10.1016/j.crad.2019.02.006.
[2] Mann RM, Hooley R, Barr RG, Moy L. Novel Approaches to Screening for Breast Cancer. Radiology. Nov 2020;297(2):266-285. 10.1148/radiol.2020200172.
[3] Luo C, Wang L, Zhang Y, Lu M, Lu B, Cai J, Chen H, Dai M. Advances in breast cancer screening modalities and status of global screening programs. Chronic diseases and translational medicine. Jun 2022;8(2):112-123. 10.1002/cdt3.21.

[4] Safdar S, Rizwan M, Gadekallu TR, Javed AR, Rahmani MKI, Jawad K, Bhatia S. Bio-Imaging-Based Machine Learning Algorithm for Breast Cancer Detection. Diagnostics (Basel, Switzerland). May 03, 2022;12(5):. 10.3390/diagnostics12051134.

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Citation Summaries

Citation: [1] Le EPV, Wang Y, Huang Y, Hickman S, Gilbert FJ. Artificial intelligence in breast imaging. Clinical radiology. May 2019;74(5):357-366. 10.1016/j.crad.2019.02.006.

Summary:

1. **Purpose** : The review explores the current limitations and future opportunities for the application of computer-aided detection (CAD) systems and artificial intelligence (AI) in breast imaging. It discusses the evolution from traditional, rules-based CAD systems in mammography to advanced AI-driven systems, including deep learning (DL) and its integration into various imaging techniques like digital breast tomosynthesis, ultrasound, and MRI.

2. **Main Conclusions** : The review concludes that while traditional CAD systems have sometimes negatively impacted radiologist performance by increasing recall rates, advanced AI-CAD systems, particularly those using deep learning, show promise in reducing false-positive rates and enhancing diagnostic accuracy. The integration of AI into emerging imaging techniques represents a significant opportunity, but practical deployment in clinical settings requires thorough validation and testing, as well as considerations of cost-effectiveness and regulatory compliance.

3. **Risks** : The review mentions risks associated with traditional CAD systems, specifically their potential to adversely affect radiologist performance and increase recall rates, which could lead to unnecessary biopsies and patient anxiety.

4. **Benefits** : Benefits of advanced AI-CAD systems include the potential to decrease false-positive rates in breast cancer screening and improve the accuracy of diagnostics across various imaging modalities.

5. **Search Methodology and Scope** : The review appears to cover a broad spectrum of literature on the evolution and application of CAD and AI in breast imaging, though specific search strategies and databases queried are not detailed. It includes significant developments and collaborations like the Digital Mammography DREAM Challenge, and discusses both commercial and emerging technologies.

6. **Selection Criteria**: The review includes a mix of historical and current technologies in CAD systems, incorporating both commercial products and research initiatives. However, detailed criteria for selecting specific studies or technologies to include in the review are not explicitly mentioned.

7. **Quality Assessment of Included Studies**: There is no specific mention of methods used to assess the quality of the studies or technologies discussed. The discussion seems to rely on general developments and examples from the field rather than a systematic quality assessment.

8. **Synthesis and Analysis**: The synthesis of findings from different studies and technologies is narrative rather than systematic, with no mention of specific statistical tests or metrics like significance levels, confidence intervals, t-test scores, or effect sizes. The analysis focuses on discussing technological advancements and their potential implications.

9. **Sources of Funding or Conflict of Interest**: The review does not specify any sources of funding or potential conflicts of interest, which could affect the impartiality of the reported findings and conclusions.

PMID: 30898381

PMCID: None

URL: https://pubmed.ncbi.nlm.nih.gov/30898381/

Citation: [2] Mann RM, Hooley R, Barr RG, Moy L. Novel Approaches to Screening for Breast Cancer. Radiology. Nov 2020;297(2):266-285. 10.1148/radiol.2020200172.

Summary:

1. Purpose:

- The review seeks to evaluate how novel techniques and technologies in breast imaging and screening can reduce breast cancer-related mortality and facilitate less aggressive treatment. It focuses on the potential of digital breast tomosynthesis, contrast material-enhanced spectral mammography, various ultrasound techniques (automated three-dimensional, transmission tomography, elastography, optoacoustic imaging), MRI (abbreviated, ultrafast, diffusion-weighted imaging), molecular breast imaging, artificial intelligence, radiomics, liquid biopsy, and breathing tests.

2. Main Conclusions:

- The review concludes that despite the limitations of current screening modalities, such as limited sensitivity and high false-positive rates, emerging technologies and methodologies hold promise for improving breast cancer screening efficiency and accuracy. These advancements could lead to earlier detection, reduced mortality, and less aggressive treatment options.

3. Risks:

- The review does not explicitly discuss specific risks associated with the new screening modalities, such as radiation exposure or false-negative results.

4. Benefits:

- The benefits highlighted include potential improvements in screening accuracy, reduced breast cancer mortality, and the possibility of less aggressive treatments due to earlier detection.

5. Search Methodology and Scope:

- The review does not detail the search methodology used to identify relevant literature, nor does it assess the breadth and depth of the included studies. The scope seems to encompass a broad range of new technologies in breast imaging and screening but lacks explicit details on the inclusiveness of the research field.

6. Selection Criteria:

- The review does not specify the criteria used for selecting studies, nor does it mention the types of studies included or excluded. There is no discussion on whether diverse perspectives or contradictory findings are addressed.

7. Quality Assessment of Included Studies:

- There is no mention of quality assessment methods applied to the included studies, making it difficult to gauge the methodologies, results, and reliability of the studies discussed.

8. Synthesis and Analysis:

- The review lacks a clear structure and methodology for synthesizing and analyzing the literature. No specific statistical tests or metrics such as significance levels, confidence intervals, t-test scores, or effect sizes are mentioned, making it challenging to interpret the robustness of the conclusions drawn.

9. Sources of Funding or Conflict of Interest:

- The review does not identify any sources of funding or potential conflicts of interest, which could impact the neutrality and credibility of the findings presented.

PMID: 32897163

PMCID: None

URL: https://pubmed.ncbi.nlm.nih.gov/32897163/

Citation: [3] Luo C, Wang L, Zhang Y, Lu M, Lu B, Cai J, Chen H, Dai M. Advances in breast cancer screening modalities and status of global screening programs. Chronic diseases and translational medicine. Jun 2022;8(2):112-123. 10.1002/cdt3.21.

Summary:

1. Purpose:

- The review addresses the effectiveness, advancements, and global implementation of breast cancer (BC) screening techniques and strategies.
- It focuses on evaluating different screening techniques like mammography, ultrasound, clinical breast examination, and emerging methods like digital breast tomosynthesis and liquid biopsies.
- The review also compares organized vs. opportunistic screening programs and scrutinizes the guidelines from various authoritative bodies on optimal screening practices.

2. Main Conclusions:

- Mammography remains the most effective and widely used BC screening technique, particularly for women at average risk.
- Screening has significantly reduced BC mortality, with meta-analyses showing a reduction ranging from 12% to 20%.
- There is a need for more personalized screening strategies tailored to individual risks to enhance effectiveness and reduce adverse outcomes like overdiagnosis and false positives.

3. Risks:

- The review highlights several risks associated with BC screening:
- Overdiagnosis estimates range from 6.5% in observational studies to 4%-11% in randomized controlled trials.
- The cumulative risk of false positives is about 20% for women screened every two years between ages 50 and 70.
- Radiation from mammography poses a risk, potentially causing BC in 2-11 per 100,000 women screened.

4. Benefits:

- BC screening, particularly mammography, significantly improves early detection, which is crucial for improving survival rates.

- Early-stage detection (carcinoma in situ) has a 99.0% 5-year relative survival rate compared to 29.0% for distant metastatic stages.

5. Search Methodology and Scope:
- The review synthesizes findings from previous studies and trials, some of which include outdated data.
- It covers a broad scope of BC screening practices globally, comparing different strategies and their outcomes across various countries.

6. Selection Criteria:
- The review includes a variety of study types, from trials and meta-analyses to observational studies.
- It seems to incorporate a comprehensive range of perspectives, though the focus is predominantly on quantitative rather than qualitative data.

7. Quality Assessment of Included Studies:
- The review does not explicitly detail the quality assessment methods used for the included studies.
- Reliability and methodologies of studies are implied to be robust as they are used to support significant claims and conclusions.

8. Synthesis and Analysis:
- The review effectively synthesizes data from various studies to compare and contrast the effectiveness and challenges of different screening techniques.
- Statistical metrics mentioned include overdiagnosis rates and false-positive risks, essential for evaluating the efficacy and drawbacks of screening programs.

9. Sources of Funding or Conflict of Interest:
- The authors declare no conflicts of interest, suggesting an unbiased presentation of the review's findings.

PMID: 35774423

PMCID: PMC9215717

URL: https://pubmed.ncbi.nlm.nih.gov/35774423/

Citation: [4] Safdar S, Rizwan M, Gadekallu TR, Javed AR, Rahmani MKI, Jawad K, Bhatia S. Bio-Imaging-Based Machine Learning Algorithm for Breast Cancer Detection. Diagnostics (Basel, Switzerland). May 03, 2022;12(5):. 10.3390/diagnostics12051134.

Summary:

1. **Purpose** : The review aims to enhance breast cancer detection and classification through computer-aided detection (CAD) systems. It examines various imaging modalities such as ultrasound, histography, and mammography. The second part of the review evaluates machine learning techniques to estimate breast cancer recurrence rates, focusing on minimizing false-positive and false-negative rates using a dataset divided into 60% for training and 40% for testing.

2. **Main Conclusions** : The review concludes that the application of machine learning techniques like SVM, LR, and KNN can significantly improve the accuracy of breast cancer classification systems. The proposed model achieved an accuracy rate of 97.7% with a false-positive rate of 0.01, a false-negative rate of 0.03, and an AUC score of 0.99, indicating high effectiveness in classifying breast tumors.

3. **Risks** : The paper does not specifically discuss the risks associated with the methodologies used, such as the potential for overfitting or the misclassification of benign tumors as malignant (or vice versa).

4. **Benefits** : The benefits highlighted include the potential for early and accurate diagnosis of breast cancer, which is crucial for improving survival rates. The high accuracy and low error rates of the proposed model suggest it could be a valuable tool in clinical settings.

5. **Search Methodology and Scope** : The research sourced information from a wide range of research databases focusing on different imaging modalities. The scope appears to be comprehensive concerning the types of imaging and machine learning techniques analyzed, though specific databases and search terms were not mentioned.

6. **Selection Criteria** : The review does not explicitly detail the criteria for selecting studies for inclusion, such as the years considered, language restrictions, or the quality of the studies. It does mention the use of various databases, which suggests a broad initial scope.

7. **Quality Assessment of Included Studies**: There is no explicit mention of quality assessment methods used to evaluate the included studies. It is unclear how the methodologies, results, and reliability of the studies were assessed.

8. **Synthesis and Analysis**: The findings from different studies are synthesized to evaluate the effectiveness of machine learning techniques in breast cancer detection. Statistical metrics mentioned include a 97.7% accuracy rate, 0.01 false-positive rate, 0.03 false-negative rate, and an AUC score of 0.99. These metrics indicate a very high level of diagnostic accuracy and model performance, with the AUC score nearing the maximum value of 1, suggesting excellent model discrimination ability.

9. **Sources of Funding or Conflict of Interest**: The research received no external funding and the authors declared no conflicts of interest. This suggests financial independence in the research, though the lack of funding could affect the scope of the research conducted.

PMID: 35626290

PMCID: PMC9140096

URL: https://pubmed.ncbi.nlm.nih.gov/35626290/