A framework for evaluating the economic impact of artificial intelligence for screening mammography: implications for facilities and payers from the US perspective

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Background

- The use of artificial intelligence (AI) in breast cancer screening is becoming more widespread.
- Amid the growing shortage of radiologists and workflow pressures, there are considerable opportunities to leverage artificial intelligence (AI) software in mammographic breast cancer screening.
- Deep learning-based AI algorithms that aid in the interpretation of screening exams have the potential to improve radiologist accuracy, confidence, and reading efficiency.
- Previous studies have demonstrated the potential of such AI to decrease radiologist reading times and workload.[1-4]
- However, current reimbursement frameworks in the US are not equipped to accommodate semi-autonomous AI algorithms, with no established payment pathways for such technology.
- The aim of this study was to evaluate the potential workflow and economic impact of AI implementation on screening mammography from both the facility and payer perspectives.

Methods

- We constructed a modeling tool in Microsoft Office Excel to evaluate the impact of AI implementation on screening mammography with two types of AI solutions:
  1. Augmentative AI: AI that detects suspicious lesions on a mammogram and generates a case recommendation, which has been shown to reduce read times; radiologist review is required for all cases
  2. Semi-autonomous AI: AI that offers the same benefits as augmentative AI, with the added feature of triaging out 'low suspicion' cases so that radiologists can focus on reviewing high-priority exams and do not need to review low suspicion exams.
- ***Exam classification & AI scenarios***
  - The model incorporates a three-bucket exam categorization approach with different AI read time reduction assumptions for each bucket (Table 1).
  - Four different potential AI implementation scenarios were evaluated:
    1. Augmentative AI for 2D+3D exams only
    2. Augmentative AI for all exams
    3. Semi-autonomous AI for 2D+3D exams only
    4. Semi-autonomous AI for all exams

Table 1. Exam classification & read time assumptions

Exam category	% of cases	Read time reduction with AI	
		Augmentative AI	*Semi-autonomous AI*
Low suspicion	70%	25%	100%
Moderate suspicion	25%	0%	
High suspicion	5%	15%	

- ***Inputs***
  - Select model inputs and values used for the base case analysis are listed in Table 2.
  - Model inputs were estimated primarily from published literature, the Merative MarketScan Commercial Claims database, and internal assumptions.
- ***Base case analysis***
  - From the facility perspective, read time savings and potential financial impact were calculated.
  - Financial impact was also evaluated from the payer perspective.
- ***Sensitivity analysis***
  - Sensitivity analyses assessed the impact of key inputs on read time savings.

Table 2. Select model inputs

Input	Base case value
Facility exam throughput (screens/year)	10,000
Backlog (number of exams)	5,000 cap
Average read time for a 2D exam without AI	1 minute
Average read time for a 2D+3D exam without AI	2 minutes
Percent of exams that are 2D+3D[5]	86%
Percent of exams that are 2D[5]	14%
Reduction in FP recalls	0%
Reduction in FP biopsies	0%
Increase in cancer detection	0%
2D screening average commercial payment[5]	$165.07
Technical component	$118.76
Professional component	$46.31
2D+3D screening average commercial payment[5]	$241.15
Technical component	$153.44
Professional component	$87.71
Augmentative AI cost/exam (2D)	$3
Augmentative AI cost/exam (2D+3D)	$3
Semi-autonomous AI cost/exam (2D)	$10
Semi-autonomous AI cost/exam (2D+3D)	$15
Add'l expenses related to AI implementation	$75,000
Reimbursement considerations	Exclusion of prof. reimbursement for exams interpreted exclusively by semi-autonom. AI; no change to technical reimbursement

Results

Base case analysis

- *Augmentative AI scenarios*
  - Under base case assumptions for a facility that screens 10,000 women per year (defined as the facility's 'normal throughput'), augmentative AI implementation could result in time savings of 52 to 57 hours of mammography exam reading time per year (Table 3).
  - These time savings could be financially capitalized on in a variety of ways. As an example, this may enable increases in screening exam throughput for clinics with a backlog of exams. If these hours were leveraged to read new screening exams, this could potentially have a positive financial impact of up to $71.0k per year. This time could also be leveraged for other radiologist tasks.
  - With the existing reimbursement structure and base case model assumptions, the anticipated impact to payers is neutral.
- *Semi-autonomous AI scenarios*
  - Semi-autonomous AI could result in greater flexibility and time savings than augmentative AI given the added triaging feature, saving 217 to 229 hours per year in radiologist reading time, which could be repurposed to increase throughput for clinics with backlogs or conduct different radiologist tasks (Table 3).
  - However, existing payment methodologies do not lend themselves to reimbursement for mammography AI services. This represents potential risk to facilities and a disincentive for adoption of semi-autonomous AI. Clear and established payment pathways are needed to address this gap.
  - Under the existing reimbursement structure, this scenario could result in substantial savings for payers, providing flexibility to consider incremental reimbursement for AI. Such payment pathways will be critical to drive adoption of semi-autonomous AI by facilities.

Sensitivity analysis

- Sensitivity analyses were conducted to analyze the impact of key inputs on potential read time savings for the two scenarios in which AI is available for all exams (augmentative AI for all exams, semi-autonomous AI for all exams) (Tables 4-5, Figures 1-2).
- *Augmentative AI*
  - Facility exam throughput and reduction in read time for low suspicion exams have the largest impact on model results.
- *Semi-autonomous AI*
  - Facility exam throughput and the percent of exams classified as low vs. moderate suspicion have the greatest impact on read time savings.

Table 3. Base case model results

	Facility Results		Payer Results
	Number of hours saved in reading time for normal throughput *(per year)*	**Potential financial impact**	**Potential financial impact**
Augmentative AI for 2D+3D exams only	52 hours	Positive, up to $59.9k	Neutral impact
Augmentative AI for all exams	57 hours	Positive, up to $71.0k	
Semi-autonomous AI for 2D+3D exams only	217 hours	Negative, up to -$10.0k	Positive, up to $379.5k
Semi-autonomous AI for all exams	229 hours	Negative, up to -$43.3k	Positive, up to $412.5k

'Potential financial impact' for facilities and payers was modeled in the base case scenario with the assumption that the professional reimbursement component would be excluded for mammography exams interpreted exclusively by semi-autonomous AI technology. It does not account for any changes to technical reimbursement.

Table 4. Sensitivity analysis: Augmentative AI for all exams – Values

Variable	Min	Base Case	Max
Exam classification			
Percent of exams classified as 1) low suspicion & 2) moderate suspicion	1) 50% 2) 45%	1) 70% 2) 25%	1) 80% 2) 15%
Read time assumptions			
Reduction in low suspicion read time	10%	25%	60%
Reduction in moderate suspicion read time	0%	0%	25%
Reduction in high suspicion read time	0%	15%	50%
Throughput			
Facility exam throughput (screens/year)	5,000	10,000	25,000

Figure 1. Sensitivity analysis: Augmentative AI for all exams – Number of reading hours saved for normal capacity exams

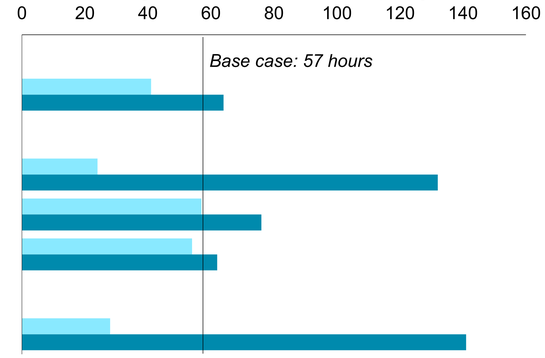
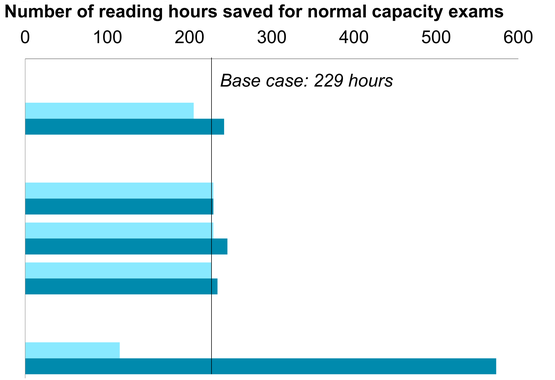


Table 5. Sensitivity analysis: Semi-autonomous AI for all exams – Values

Variable	Min	Base Case	Max
Exam classification			
Percent of exams classified as 1) low suspicion & 2) moderate suspicion	1) 50% 2) 45%	1) 70% 2) 25%	1) 80% 2) 15%
Read time assumptions			
Reduction in low suspicion read time	100%	100%	100%
Reduction in moderate suspicion read time	0%	0%	25%
Reduction in high suspicion read time	0%	15%	50%
Throughput			
Facility exam throughput (screens/year)	5,000	10,000	25,000

Figure 2. Sensitivity analysis: Semi-autonomous AI for all exams – Number of reading hours saved for normal capacity exams



Conclusions

- Augmentative AI may offer substantial flexibility and opportunity for facilities. Potential time savings from AI implementation could drive positive financial impact by enabling increases in mammography exam throughput and/or other radiologist tasks. Additionally, AI implementation could help mitigate radiologist shortages, relieve current workflow pressures, and increase radiologist confidence and accuracy. Under the current reimbursement structure, augmentative AI could have a neutral impact on payers.
- Looking ahead, semi-autonomous AI may offer even greater flexibility for facilities and potential savings for payers; however, existing payment methodologies do not lend themselves to reimbursement for mammography AI services. Clear and established payment pathways for semi-autonomous AI will be critical to drive adoption by facilities.

References

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[5]Merative MarketScan commercial claims data, 2023

Disclaimers:
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