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Mitigating environmental toxicity & institutional economic burden: A life-cycle assessment of risk-stratified breast cancer screening pathways.

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Background

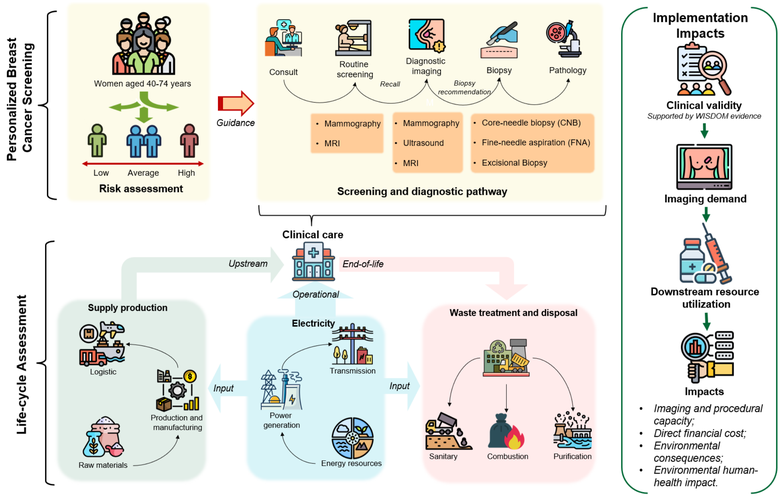
- Risk-based personalized screening changes who gets screened, how often, and with which imaging modalities [1].
- The system-level consequences for healthcare resource use, costs, and environmental impacts remain poorly understood.
- Healthcare accounts for approximately 8.5% of U.S. greenhouse gas (GHG) emissions [2], with radiology contributing substantially—more than 50%—to hospital emissions [3].
- ***Research Question***: How does personalized breast cancer screening affect healthcare resource use, costs, and environmental impacts?

Takeaways

- *Personalized screening can make breast cancer screening more targeted and resource-efficient, but its system-level impacts should be evaluated across the entire patient pathway—not at a single screening stage.*
- *Its benefits depend on the comparison strategy, population risk distribution, and adherence to reduced-frequency screening.*

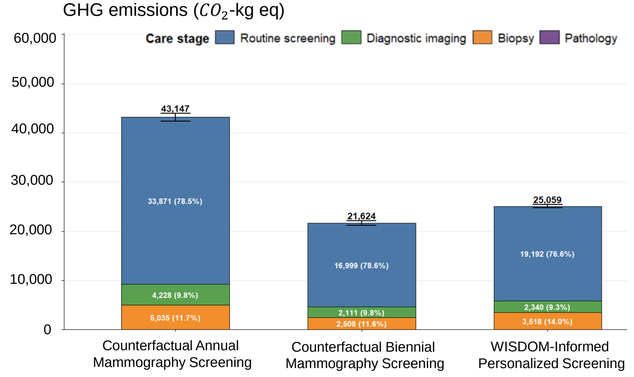
Methods

- ***Comparison:*** Personalized screening vs. annual and biennial mammography [4,5].
- ***Model:*** Patient screening pathway integrated with a life-cycle assessment model [6].

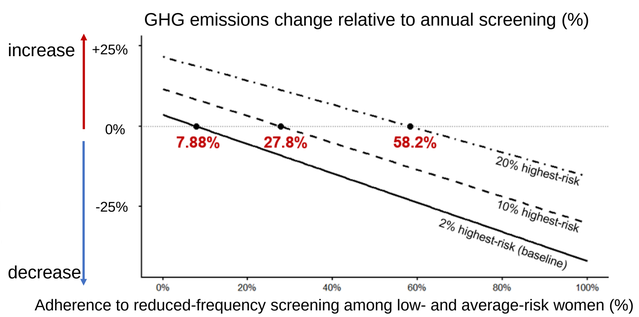


- ***Modeled Population:*** 14,212 women, with risk distribution informed by the WISDOM trial (Women Informed to Screen Depending on Measures of Risk) [7].
- ***Risk groups:*** Lowest, average, elevated, and highest risk [7].

Results



- ~42% lower GHG emissions vs. annual screening.
- ~16% higher GHG emissions vs. biennial screening.
- Direct financial costs and environmental human-health impacts (DALYs) showed similar patterns across screening strategies.
- At the baseline risk composition, **~8%** adherence to reduced-frequency screening was sufficient to retain an emissions benefit vs. annual screening.



Other Findings

- Personalized screening redistributed imaging resources toward women at higher breast cancer risk.
- Environmental findings remained robust under alternative low-carbon electricity and non-incineration waste-disposal scenarios.

Future Directions for Research

- Optimize personalized screening based on local imaging capacity.
- Incorporate patient wait times, imaging throughput, radiologist workload, and interpretation time.
- Integrate clinical practice and hospital operations into healthcare decarbonization efforts.

References & Affiliations

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