Laboratory-Based Machine Learning Algorithm Reduces Economic Burden by Enhancing Diagnostic Accuracy and Clarity in Periprosthetic Joint Infection

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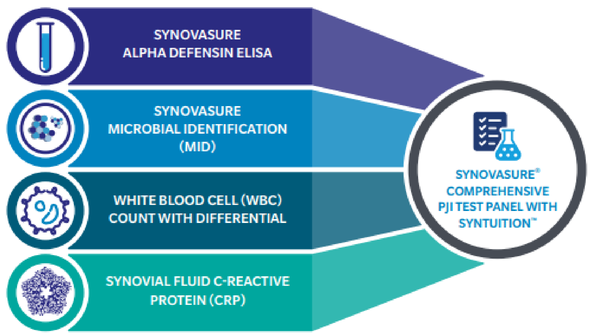
OBJECTIVES

Periprosthetic joint infection (PJI) diagnosis remains complex, with erroneous application plus implementation challenges of the current standard of care (SOC) methods. Diagnostic uncertainty may default to unnecessary two-stage revision surgeries and antibiotic overuse.

This analysis assessed the potential economic impact of integrating the SynTuition™ machine-learning (ML) algorithm, which interprets synovial fluid biomarkers from the Synovasure® Comprehensive PJI Test Panel, into the diagnostic pathway from a U.S. payer perspective.



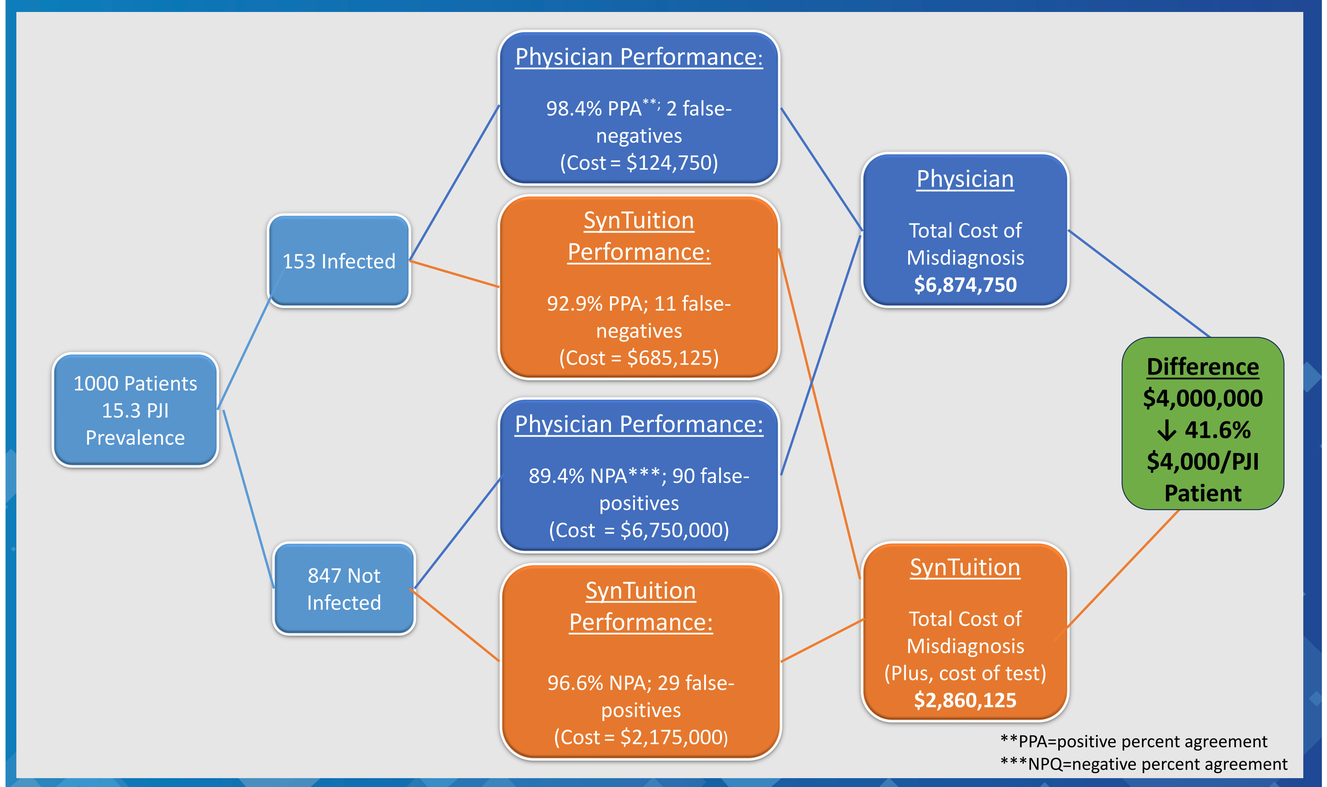
METHODS

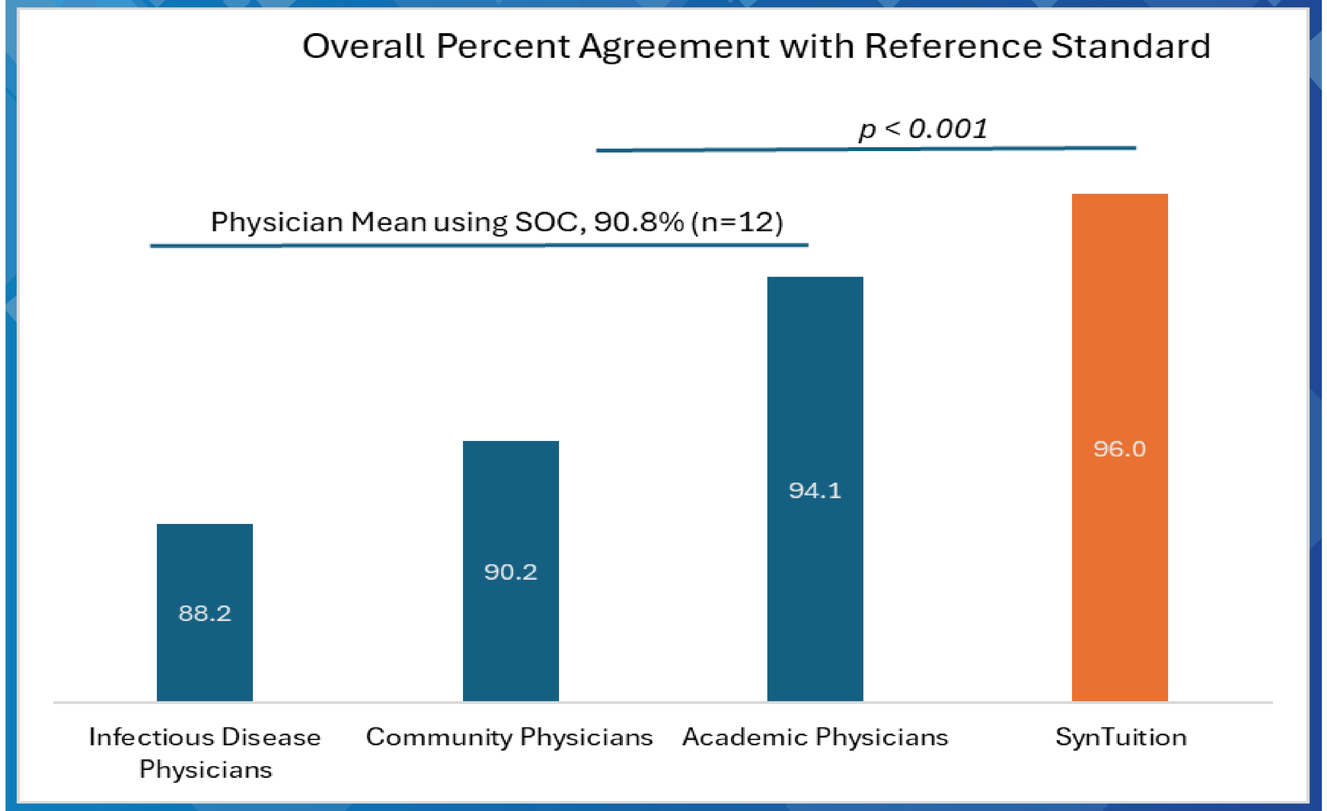
A decision-analytic model simulated 1,000 suspected PJI evaluations.

Modeled misdiagnosis costs were compared between a panel of physicians and SynTuition using diagnostic performance assessed against the SOC 2018 International Consensus Meeting (ICM) criteria, with inconclusive cases adjudicated by expert physicians.

SynTuition™* reduces the overall economic burden of misdiagnosed PJI by $4000 per suspected PJI patient compared to a physician panel

Costs schematic comparing SynTuition to the current standard of care by a physician panel





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*SynTuition is available as a laboratory-developed test (LDT). SynTuition is not available in New York State.

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METHODS

Disease prevalence was 15.3%.
False Negative: $62,375 (50% repeat testing $1,000; 50% revision $123,750)
False Positive: $75,000 (Unnecessary revision)

RESULTS

- The inconclusive rate and diagnostic accuracy was 22.9% and 90.8% by physicians and 0.4% and 96% by SynTuition, respectively.
- SynTuition demonstrated greater ability to accurately differentiate diagnostically ambiguous results compared to physicians. When cases were labeled *inconclusive* under current diagnostic criteria, physicians remained uncertain 38% to 48% of the time. SynTuition provided a definitive answer for all cases and correctly classified 86.7% of them.
- Physicians predominantly defaulted to a false-positive diagnosis in inconclusive cases, leading to lower overall accuracy.
- Compared to physicians using SOC, SynTuition reduced false-positives and overall costs from nearly $6.9M (92 errors) to $2.8M (40 errors).

CONCLUSION

Implementing SynTuition to aid diagnosis of suspected PJI reduced the rate of false results, particularly false-positive results, which can lead to unnecessary two-stage revision surgery and high-dose systemic antibiotics.

CLINICAL SIGNIFICANCE

SynTuition, overall U.S. payer costs were reduced by over 50%, amounting to an estimated net savings of $4,000 per suspected PJI.

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