

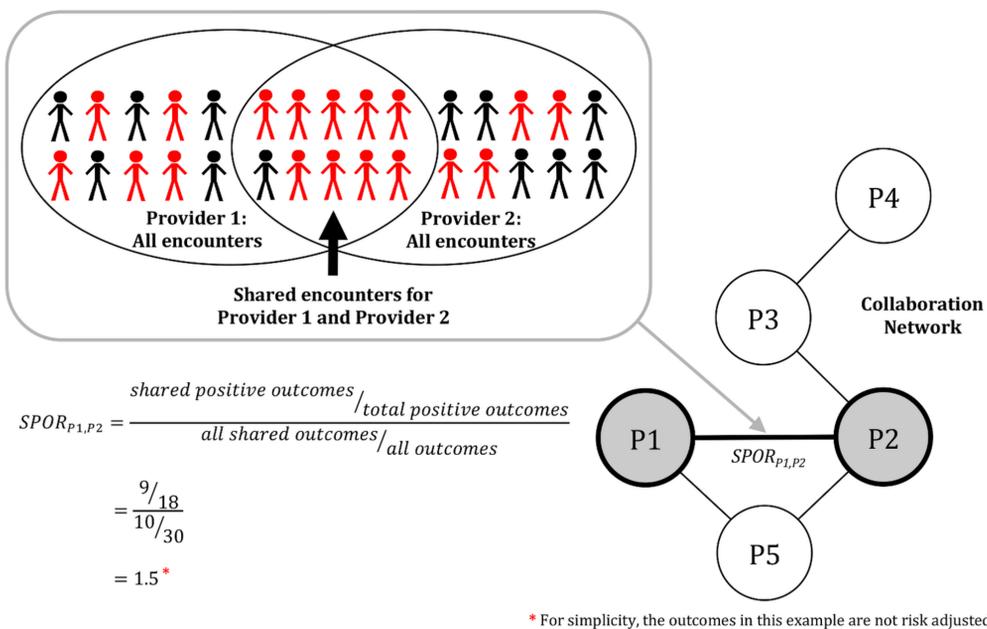
## Background

- Shared patient encounters form the basis for collaborative relationships, which are crucial to the success of interdisciplinary teamwork in healthcare.
- Quantifying the strength of these relationships using shared risk-adjusted patient outcomes provides insight into interactions that occur between healthcare providers in a hospital setting.
- A network-based approach to quantify teamwork quality could characterize clinical processes, facilitate quality improvement (QI), and become an important tool in learning healthcare systems.

## Objectives

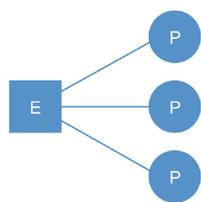
- To establish a generalizable, graph-based framework for measuring the Shared Positive Outcome Ratio (SPOR), an objective composite measure that quantifies the concentration of risk-adjusted positive outcomes for each pair of providers over a set of shared patient encounters.
- To demonstrate this method using a set of 1,104 cardiology unit encounters, associated providers, and an outcome indicating patient satisfaction.

## Methods



The **Shared Positive Outcome Ratio**, or **SPOR**, weights relationships according to the relative success of a provider pair. The SPOR answers this question: ‘How many more good outcomes do these two providers achieve when they work together versus when they work with other providers?’ If the rate of satisfaction was the same *inside* the overlap as it is *outside* of the overlap, the SPOR would be 1, which is the expected value. In this example, however, both providers have greater success when working together (i.e., inside the overlap) and the SPOR value is greater than 1. This metric was calculated for each pair of providers in the network.

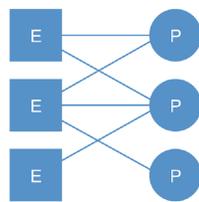
Identify providers associated with each encounter



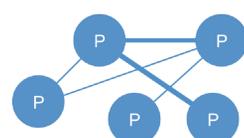
Adjust outcomes using patient acuity (risk-adjustment factor)

Outcome	Acuity	Adjusted Outcome
0	4	0.17
1	3	0.72
0	3	0.22
1	2	0.68
1	1	0.87

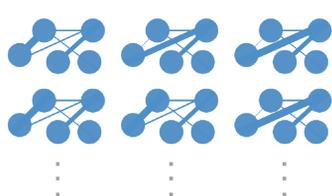
Create a bipartite network of encounters and providers



Create a collaboration network with SPORs as edge weights



Generate a set of SPOR-weighted collaboration networks based on randomized adjusted outcomes

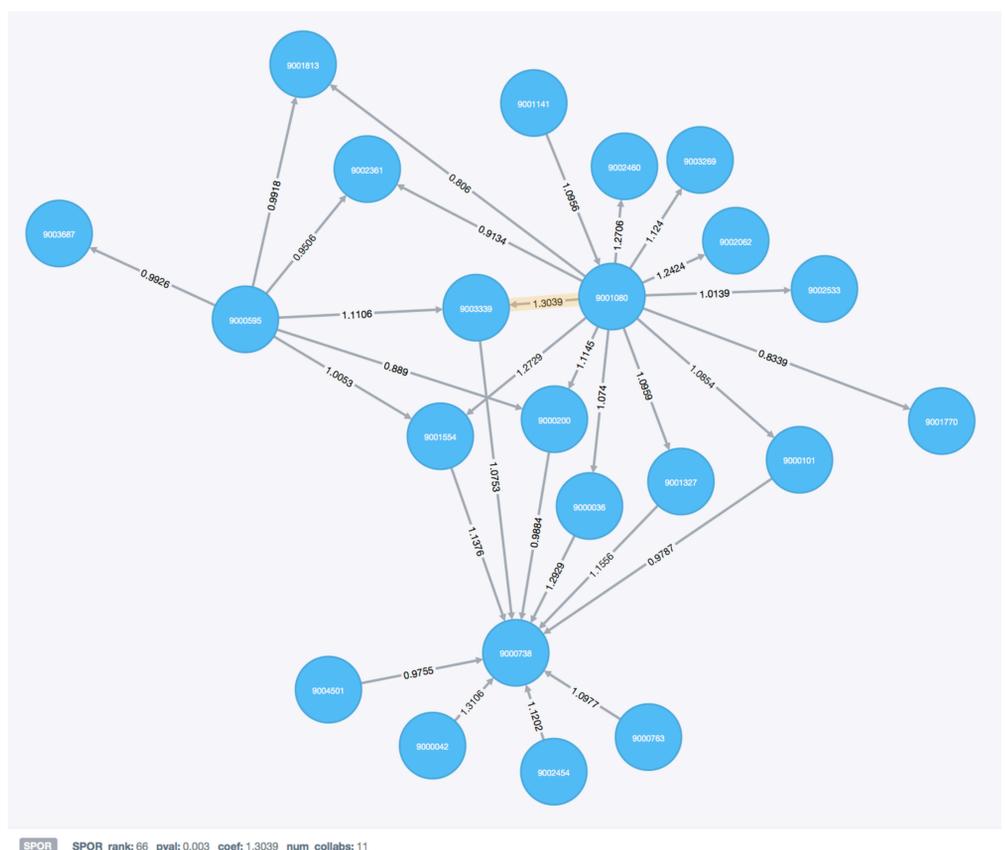


Compare “real” to “random” SPORs to find significant collaboration scores

P1,P2	R1	R2	R3	Obs
1,2	0.7	1.1	0.8	0.9
2,3	0.9	1.2	1.0	1.4
2,5	1.3	0.7	0.9	0.5

## Results

An example provider collaboration network showing 22 providers and 30 SPOR relationships. Properties associated with the highlighted edge (yellow) including the SPOR rank, an indication of the significance of the SPOR coefficient (p-value), the SPOR coefficient, and the number of shared patient encounters between the two providers (num\_collabs), are shown in the bottom left. The proximity of nodes to each other is based on the SPOR coefficient, with high-scoring relationships being shorter in length and low-scoring relationships being longer.



## Conclusion

- We identified extreme high- and low-scoring relationships over a set of shared patient encounters and quantified high variability in collaboration between providers.
- Our study shows that a healthcare collaboration network can be structurally evaluated to gain insight into the collaborative interactions that occur between healthcare providers in a hospital setting.

## References

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- Carson, M. B., Gravenor, S. J., Scholtens, D. M., Frailey, C. N., Kricke, G. S., and Soulakis, N. D. **An outcome-weighted network model for characterizing collaboration.** *PLoS ONE.* Oct 5, 2016. DOI: 10.1371/journal.pone.0163861. PMID: 27706199.

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