



VANDERBILT UNIVERSITY

# Measuring Changes in Research Funding Relationships between Industry Reporting Entities and Teaching Hospitals from Pre- to Intra-COVID-19: A Network Analysis Study

Marco Barbero Mota<sup>1</sup> Michelle Gomez<sup>1</sup> Kaitlin Williamson<sup>1</sup> You Chen<sup>1</sup>

<sup>1</sup>Department of Biomedical Informatics, Vanderbilt University Medical Center; Nashville, TN, USA



## Objective

To investigate the effect of the COVID-19 pandemic on the research investment relationships between the healthcare industry and US hospitals.

## Definitions

### Reporting entities

Payors in the healthcare industry who report CMS their transactions to teaching hospitals:

- GPOs: Group purchasing organizations
- Pharmaceutical companies
- Medical device manufacturers

### Node centrality measures

- **Degree:** number of edges of a node
- **Eigenvector centrality:** measure of the relative importance of a node in a network based on the score of its neighbours (e.g. Google's PageRank)
- **Betweenness:** fraction of the shortest paths between every pair of nodes in a network that passes through a node
- **K-core number/degeneracy:** measure of the maximum degree within a subnetwork.

## Methodology

### Data

Centers for Medicare & Medicaid Services Open Payments Research 2019 and 2020 [1].

Network attribute	2019	2020
Number of hospitals	758	730
Number of reporting entities	532	519
Network density (pre- $\chi^2$ filter)	43%	42%
Network density (after- $\chi^2$ filter)	7.5 %	7.3%
Max k-core	67	69
Core nodes	92	94
Number of transactions	8859	8518
Total funds (\$B)	≈1.481	≈1.468

Table 1. Network attributes for both 2019 and 2020.

## Take home message

COVID-19 drove a core centered accumulation of industry research investment within the US hospitals common payors network.

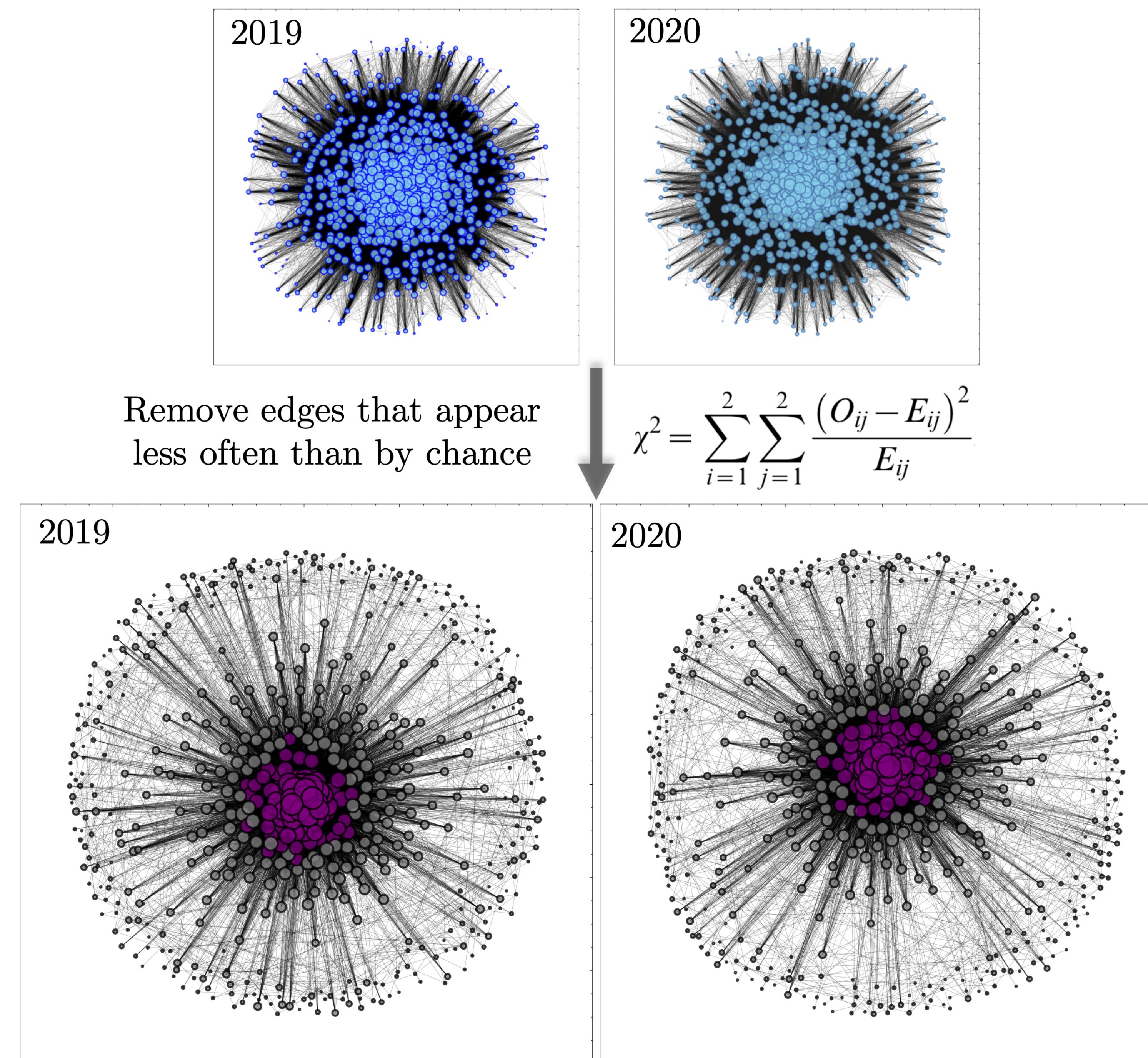


Figure 1. Application of Pearson's  $\chi^2$  test for independence (Yates correction, 1-df, p-value < 0.05 ) to the raw common payors network allows to remove weak connections and lower network density without altering its underlying structure, facilitating the analysis.

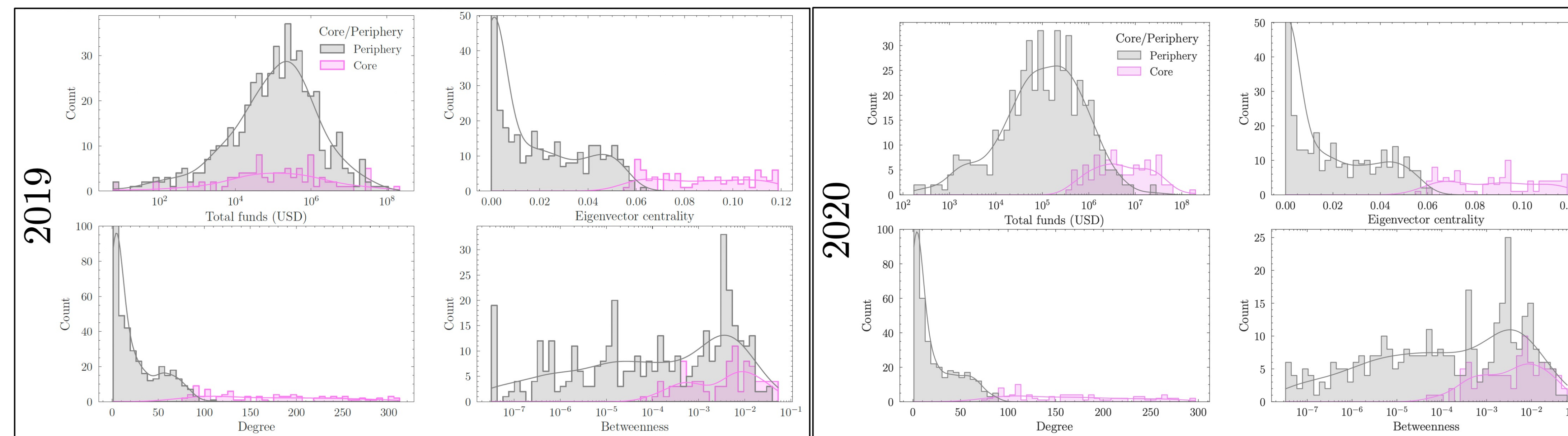


Figure 2. Funds distribution as well as main node-level network characteristics for both 2019 and 2020  $\chi^2$ -filtered networks core and periphery.

## Common payors network

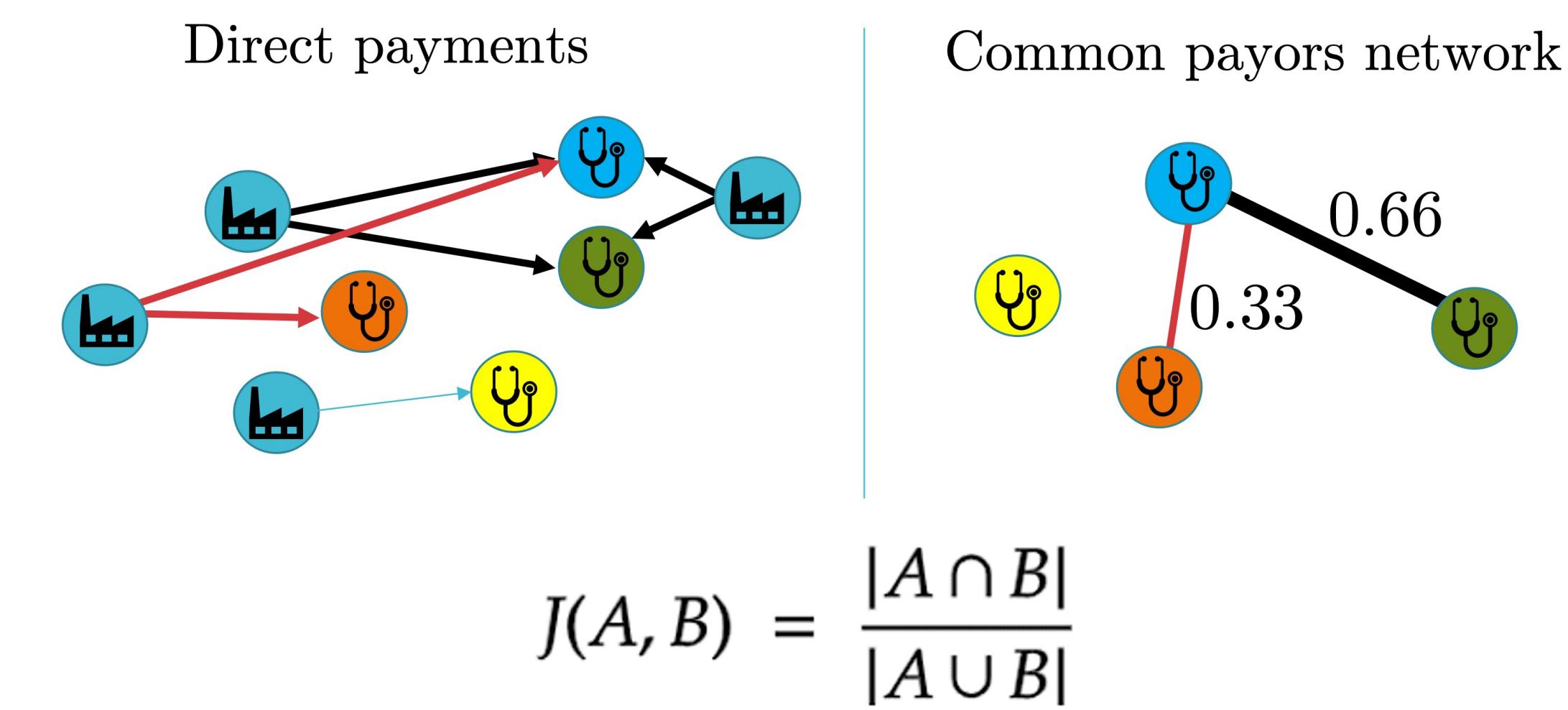


Figure 3. Rationale behind the common payors network formation from direct corporation to hospital payments data.

## Core - Periphery structure

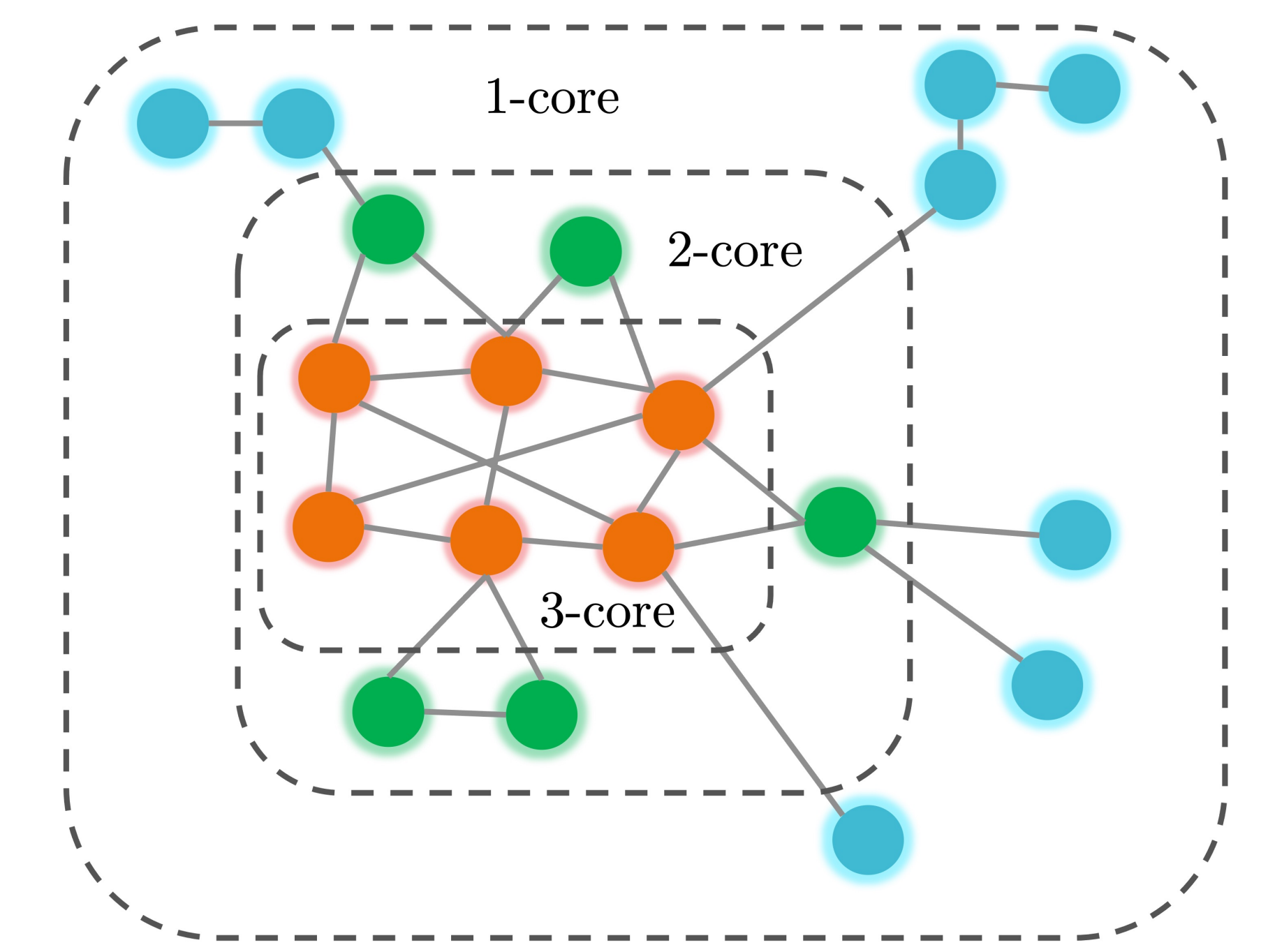


Figure 4. Example of a trivial network and its k-cores. In this study the Core/Periphery distinction was based on the maximum k-core number for each  $\chi^2$  filtered network.

## Conclusions

1. 2019 and 2020 common payors networks displayed **very similar attributes**
2. Also, an **identical core-periphery disposition**
3. **2020 showed a significantly larger core funds concentration**, which suggests that the pandemic may have promoted a **shift in industry research investment interests**.

## References

[1] OpenPayments. URL: <https://openpaymentsdata.cms.gov/>.