

# STAT 992: Project proposal

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# Summary

- We are studying the effect of intra-hospital physician referral networks on readmission and mortality data of that hospital for some hospitals located in WI, USA
- Qualitatively, location, gender and experience diversity of participating physicians, as well as the coreness (i.e. depth) of referral network seems to be highly correlated with readmission and mortality AHRQ (Agency for Healthcare Research and Quality) measures

# Summary

- Future work involves
  - a. quantifying the relationship between readmission and mortality AHRQ measures
  - b. Studying inter-hospital networks and looking at the correlation between centrality of a certain hospital in the referrals by physicians between hospitals

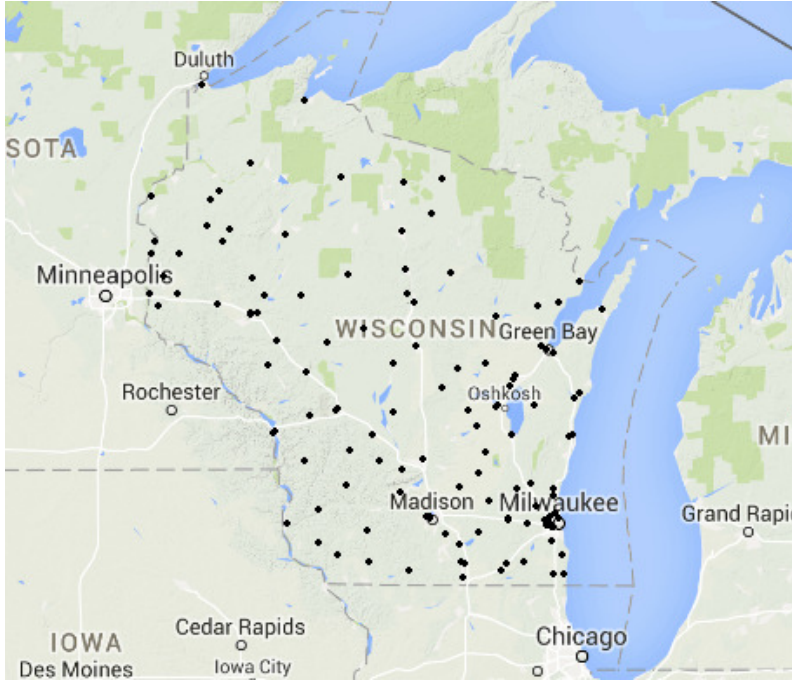
# About data

We received hospital compare data (readmission and mortality) from

We received physician compare data from

We received physician referral data from

# Hospital data



Hospital locations on WI map

126 Unique hospital provider IDs

As expected higher density at Milwaukee, Green Bay, Madison

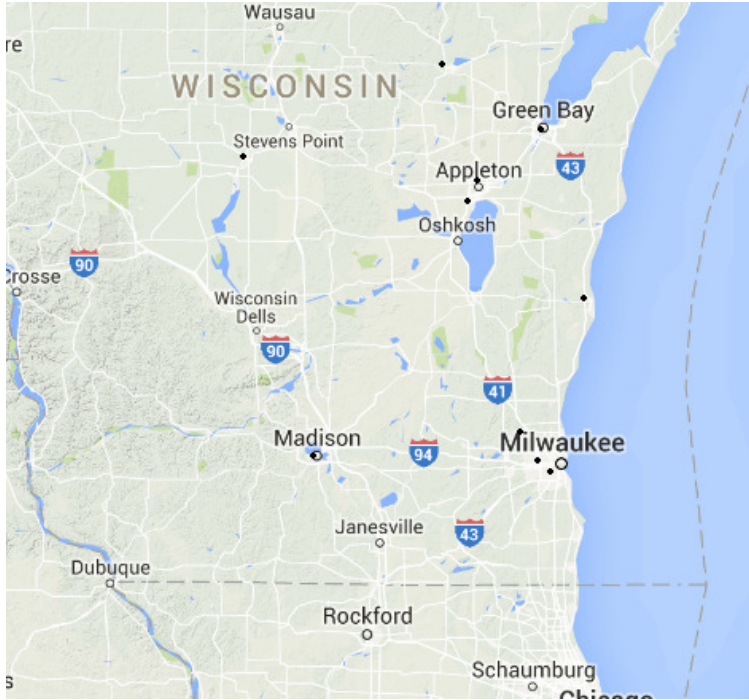
14 'risk adjusted'<sup>[1]</sup> measures of readmission and mortality based on medical condition recorded at admission and on treatment type for each hospital (not necessarily reported for each hospital in the data)

[1]: CMS Medicare Hospital Quality Chartbook 2013

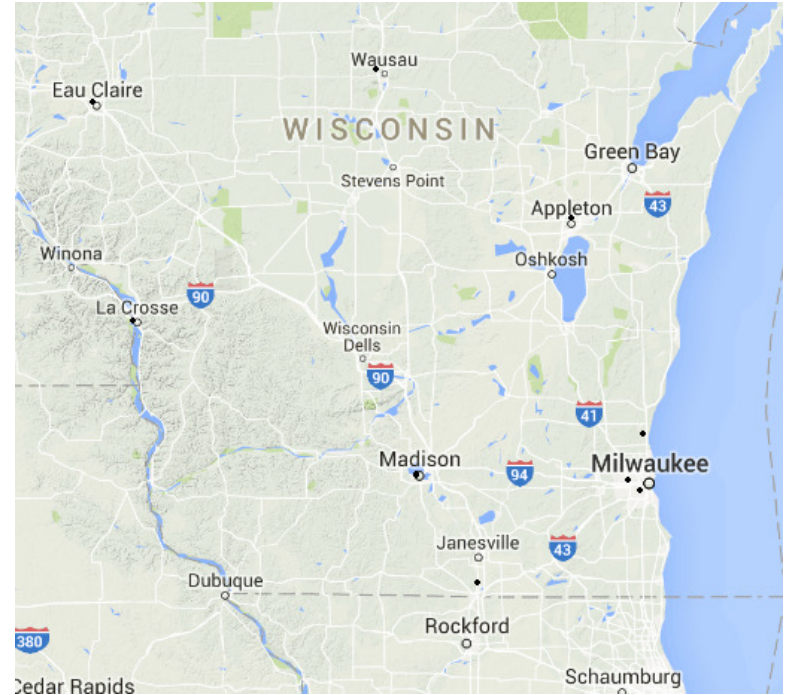
# AHRQ scores

- 14 Risk adjusted scores based on medical condition and treatment type
- National average scores for each category recorded in the national data
- If the 95% confidence higher estimate for rate of readmission/mortality of a certain hospital for a certain medical condition treatment is below the national average for that category, hospital considered better than the national average
- If the 95% confidence lower estimate for rate of readmission/mortality of a certain hospital for a certain medical condition treatment is above the national average for that category, hospital considered worse than the national average
- Everything else considered at the same level as national average

# Better and worse hospitals on the map



10 worse hospitals on WI map



10 better hospitals on WI map

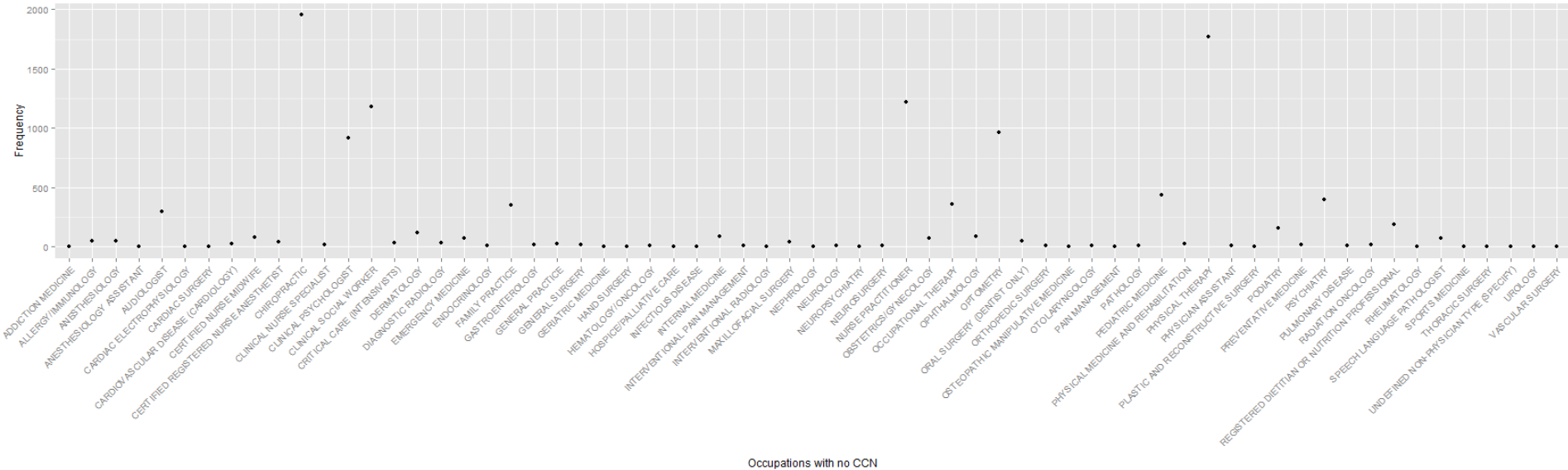
# Physician data

- Each medical practitioner has a unique NPI
- Each NPI 'should' have at least one CCN – CCN 'ties' a medical practitioner to one or more hospitals
- Some practitioners have multiple CCNs based on affiliations
- In the present data this CCN documentation seems to be based on the number of medicare claims submitted by the practitioner through a certain hospital



# CCN numbers absent

- 11452 physicians entries with 6513 unique NPIs did not have a CCN associated with them out of 49650. Why is there no CCN?



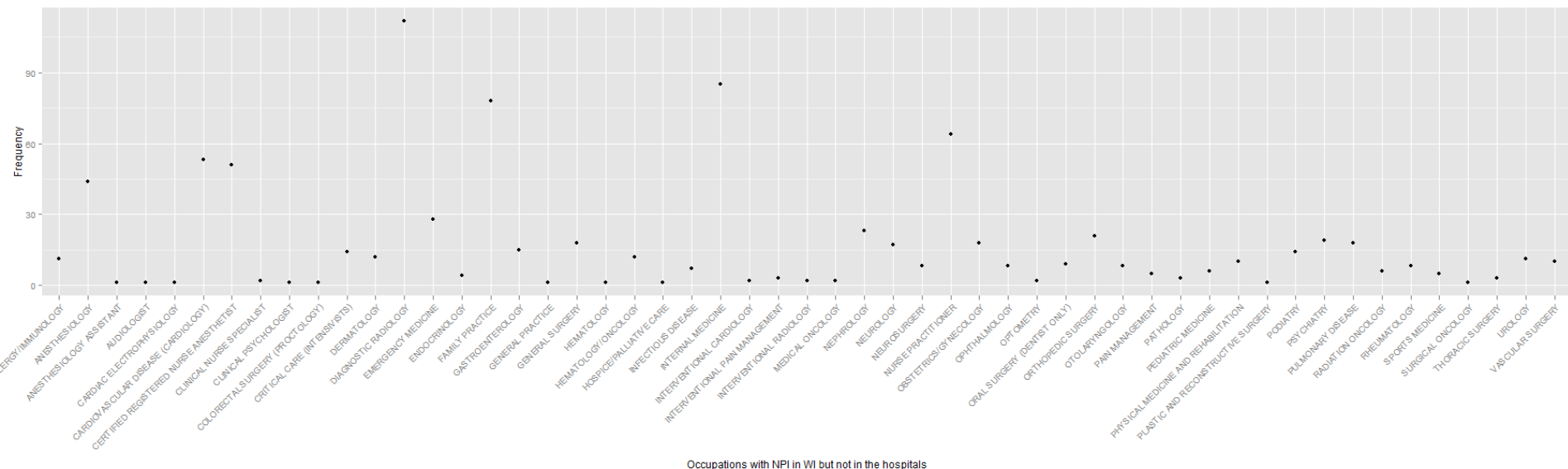
About 9000 of them seem to be individual practitioners – chiropractors, physical therapists, NPs and so on

# Multiple CCNs

- 24313 physicians out of 36687 (just over 66%) had multiple CCNs indicating multiple hospital affiliations (2 – 5)
- We have to disregard these – this is the greatest limitation of the analysis at this point
- There is no way to know which physician sent out (or received) exactly how many referrals from each of the hospitals he/she is affiliated to
- We are only considering CCN1 at first, since that is the most populated column and therefore indicates some preference, but we do not know if this is true or false or the reason behind it

# Some provider IDs not in the hospital data

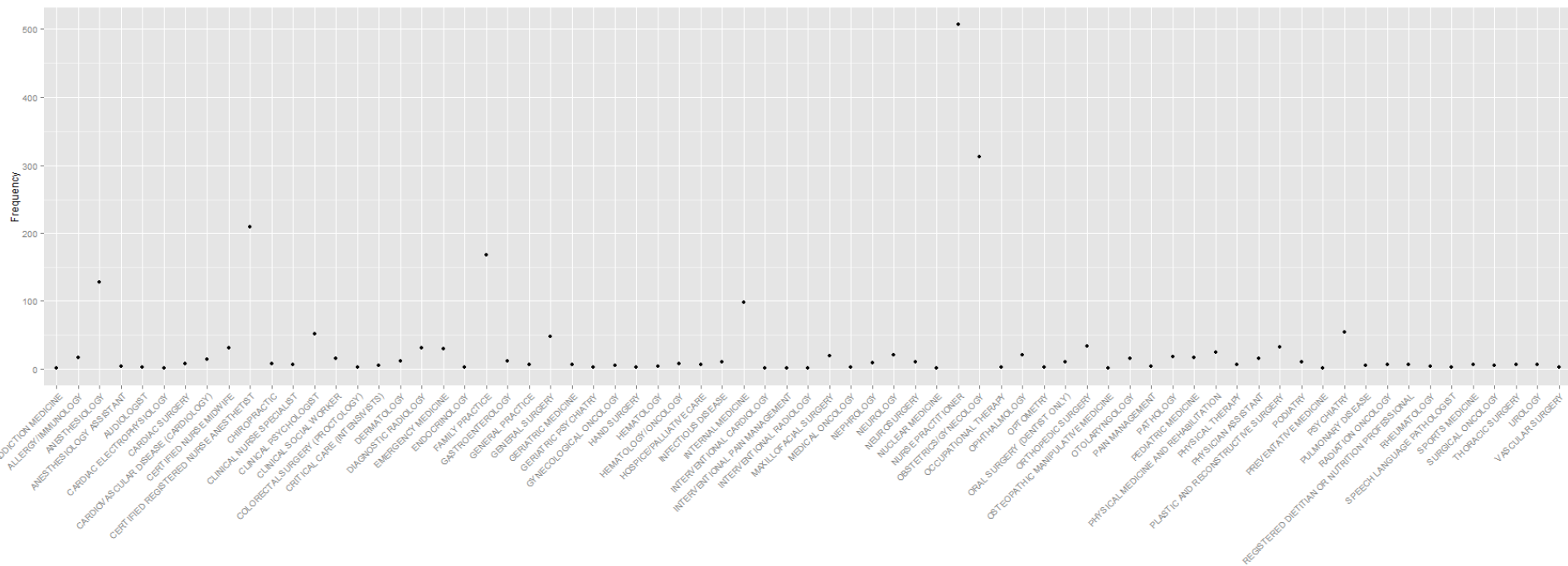
- After filtering for provider ids found in the “hospital compare” data, further 1511 entries in physician details with 861 unique NPIs were filtered out



Some of these can have individual practice, but internal medicine and cardiology are also present

# Physician in these hospital system not in referral data

2156 physicians in WI who had a CCN1 number were not in the referral data.

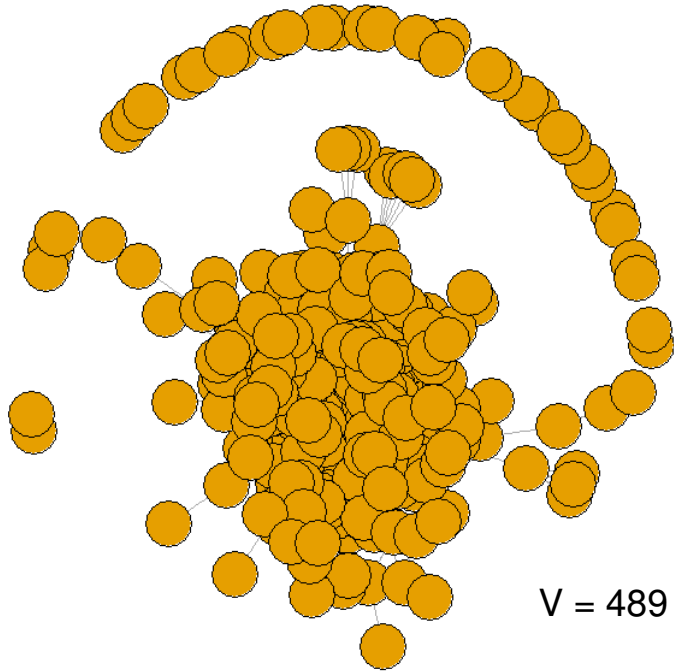


# Intra hospital data

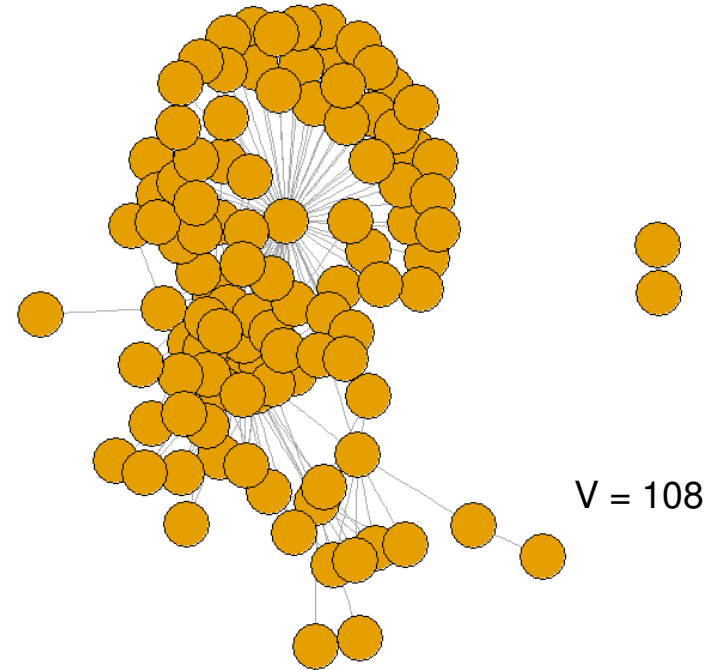
Intra hospital data shows interesting trends for hospitals, and there is a good amount of contrast in the network properties (coreness, no of edges and nodes) between hospitals that have performed better than national average, and the hospitals that have performed lower.

We will present a few qualitative and quantitative measures and our plans for future exploration/analysis of the data.

# Intra-hospital network: best hospital vs worst hospital

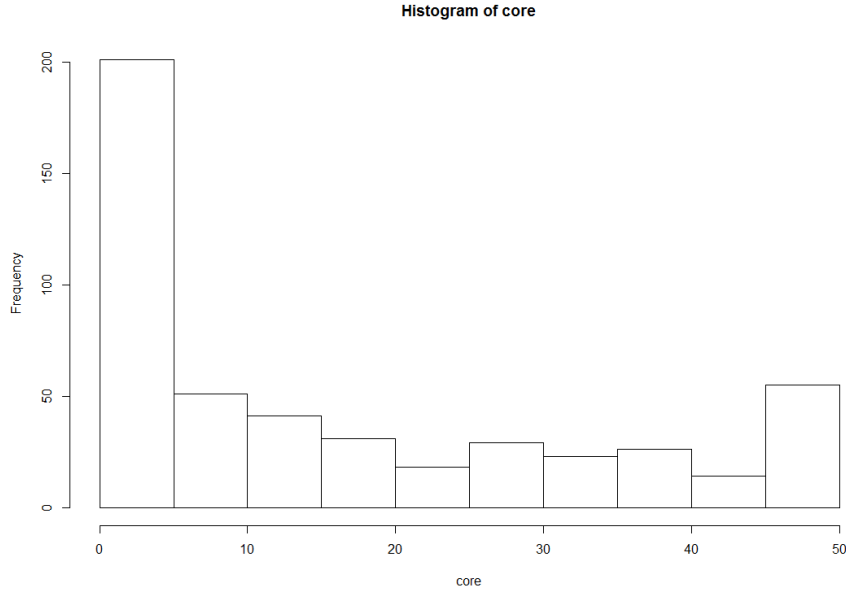


Physician referral network within one of the best hospitals in the data

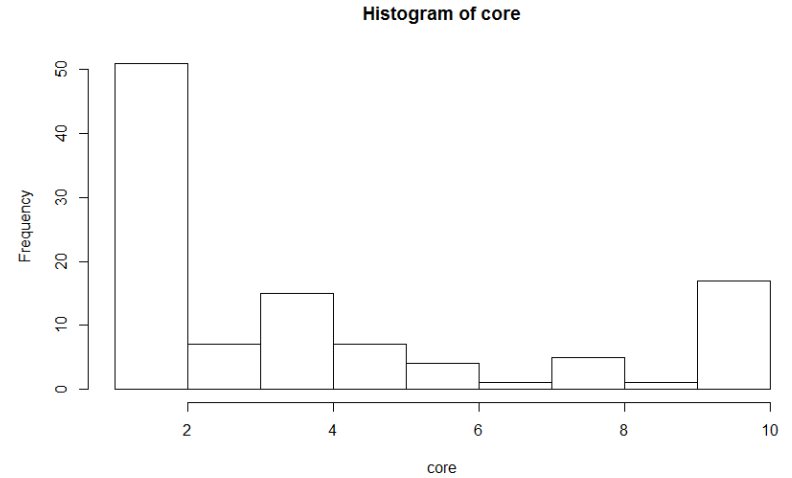


Physician referral network within one of the worst hospitals in the data

# Intra-hospital network: best hospital vs worst hospital

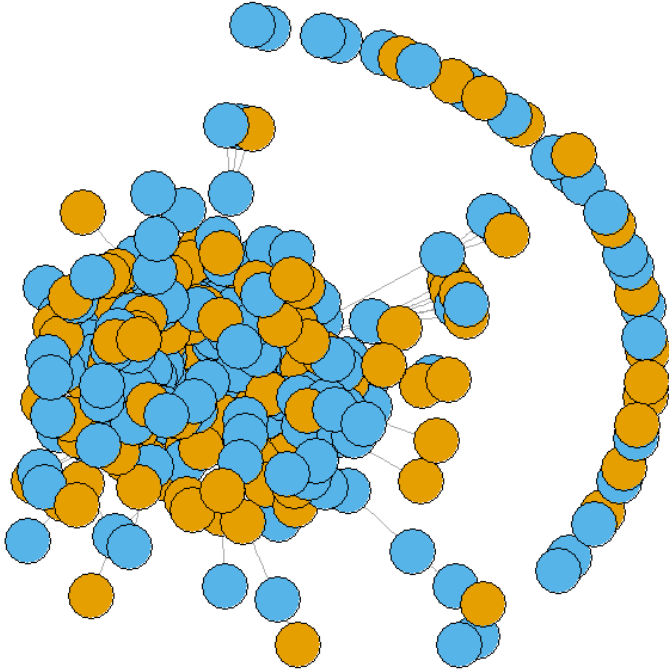


Core histogram for the physician network within one of the best hospitals in the data

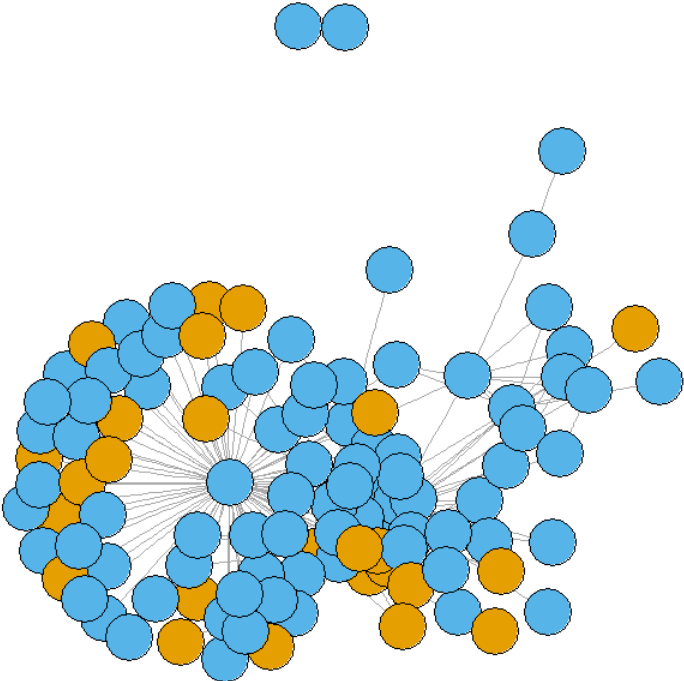


Core histogram for the physician network within one of the worst hospitals in the data

# Gender diversity



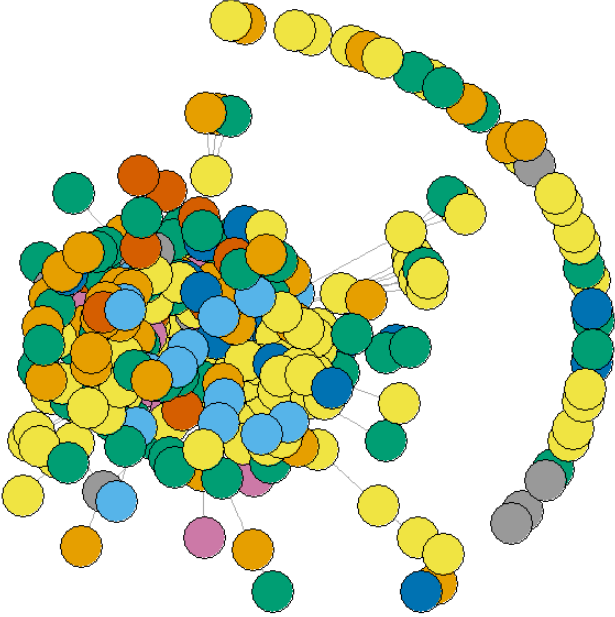
Gender diversity – one of the best hospitals



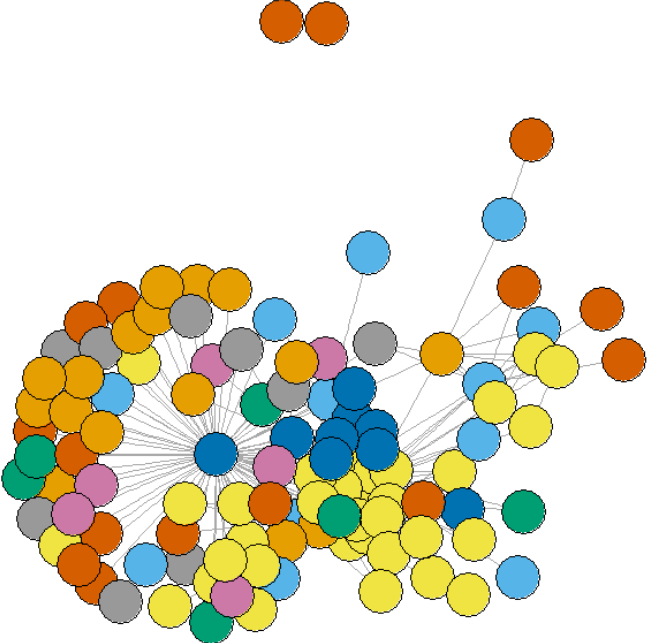
Gender diversity – one of the worst hospitals



# Primary speciality



Primary specialty of physicians –  
one of the best hospitals



Primary specialty of physicians –  
one of the best hospitals

# Zip code analysis

Since we are considering intra-hospital referrals, zip code analysis reduces the detail in the patient movement. We have done clustering based on zipcodes, but individual physician is a better analysis unit.

# Future steps

Look at similar sized graphs to see if similar trend also emerges between a comparison of such graphs

Look at hospitals that have performed no better or worse than the national average and see if the network structure detail is sufficient to differentiate between 2 levels that fall within the average category

Regression? e.g. Number of referrals within one CCN1 (hospital) regressed with readmission score or hypothesis testing: Null: Number of referrals does not affect readmission score

Thank you!