UNM HEALTH SCIENCES CENTER

Clinical & Translational Science Center

Accelerating Discoveries Toward Better Health

Using Social Network Analysis to Depict the Structure of Research Collaboration

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CTSA Clinical & Translational Science Awards®

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Background

- Research funding agencies increasingly prioritizing research that involves collaboration
- Social network analysis (SNA) one analytic tool useful for depicting collaborations
- In the U.S., NIH Clinical and Translational Science Awards aim to transform academic HSCs and speed basic science → widespread interventions
- CTSA strategy
  - Campus-wide pilot grants - preliminary data and structured opportunities for collaboration
  - Multiple collaborators viewed more favorably than single investigators – potential for formation of long-standing teams
- Little is known about the characteristics of such teams, including their composition

Purpose

- To examine the structure of internal pilot grant collaborations in the first four years of the University of New Mexico Health Sciences Center (UNM HSC) CTSC in the U.S. using social network analysis

Methods

- **Study Design:** Secondary analysis, retrospective document review of 4 years of pilot grant applications. Pilot grants open to PIs from any of 3 college/schools at UNM HSC (College of Nursing, College of Pharmacy, 19 School of Medicine departments)
- **Sample:** 121 awarded pilot grant applications (Year 1 = 24; Year 2 = 34; Year 3 = 40; Year 4 = 23)

Methods: Procedures

- Two reviewers examined face pages/biosketches to identify college/departmental affiliation of collaborators (inter-rater agreement = 90%)
- Only included internal UNM collaborations
- "Collaborators": Any faculty, research scientists, post-docs
- Did not include biostatisticians if no faculty title or just a technical data analysis role
- Did not count collaborations within departments
- If multiple collaborators from same department, only counted as one instance of collaboration

Methods: Measures

- **Basic Structure**
  - Node: A UNM College or Department
  - Edge: The lines between departments (nodes) illustrating collaborations on pilots. Thicker lines mean more collaborations
- **Density:** Number of total lines (collaborations) between departments divided by the maximum number of possible collaborations. Normalized range 0-1 (1 = "complete network") Represents communication within network (higher numbers >0.3 suggest greater communication flow and network cohesion) Inverse relationship to group (network) size.

Methods: Measures

- **Degree Centrality:** The percent of all direct collaborations that involved a given college of department. Departments with many connections can influence resources and play a key role in flow of information
- **Betweeness Centrality:** The frequency a department lies on the shortest path connecting all other departments in the network. The degree to which a department occupies a strategic position in the network.

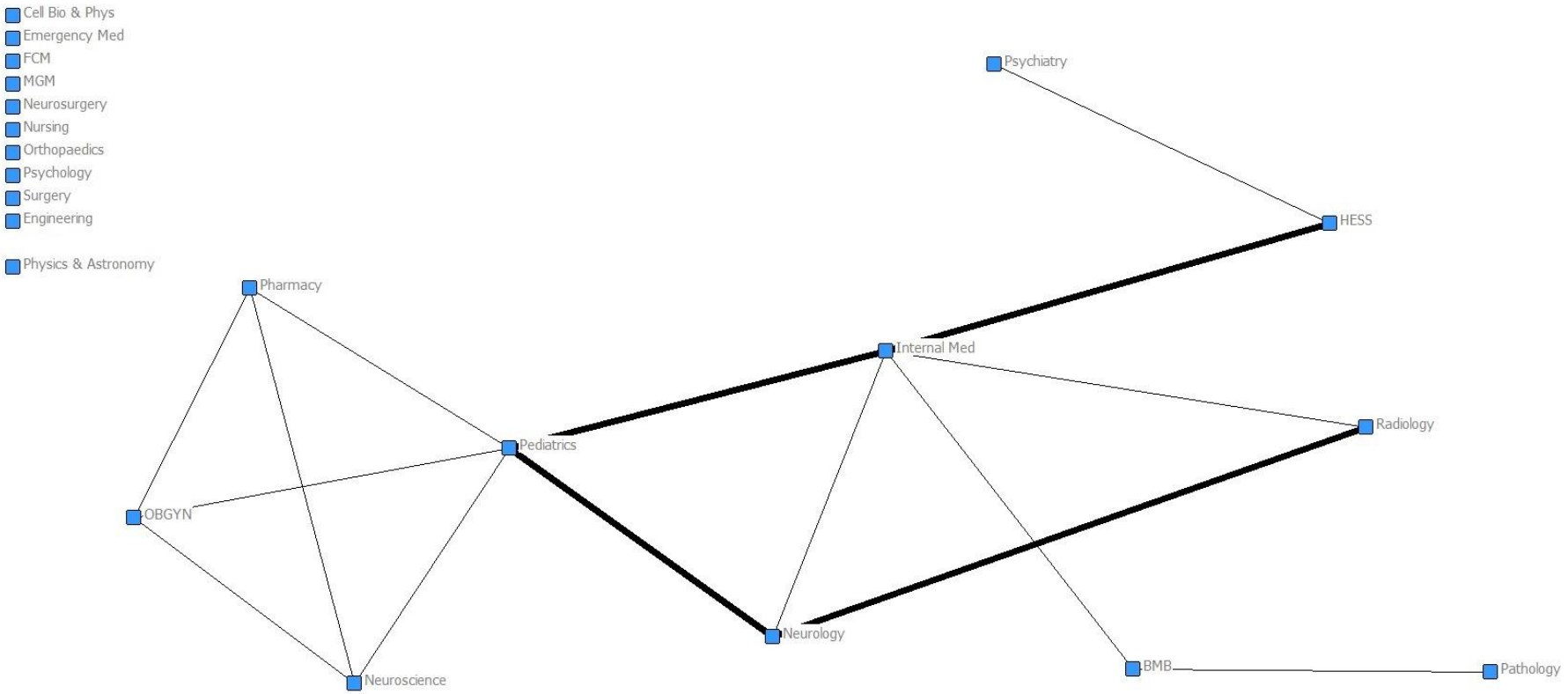
Methods: Analysis

- Data matrices of collaboration counts developed
- UCiNet software for analysis of network density, degree centrality, betweeness centrality
- Sociograms generated using compatible NetDraw software

Summary of Measures: Individual Years 1-4

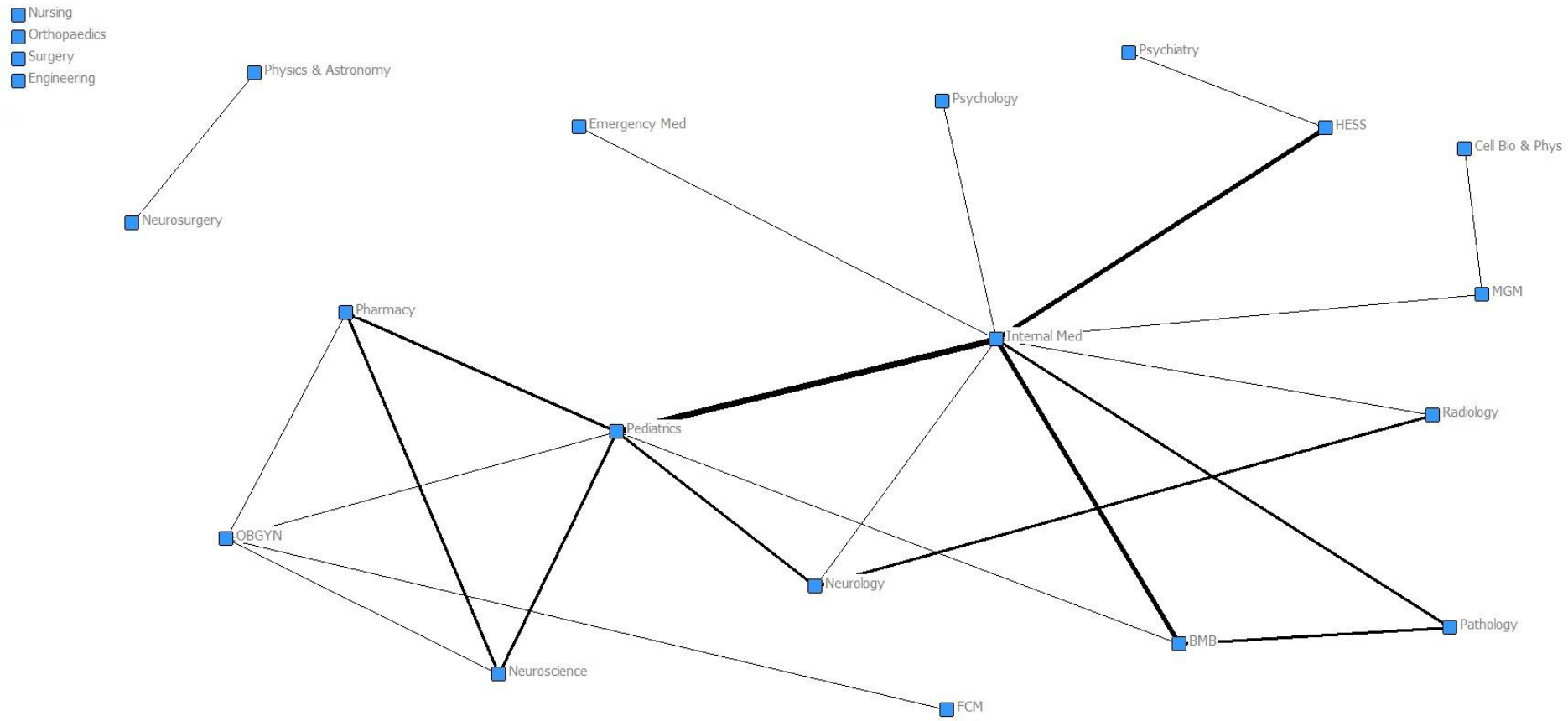
Network Metric	Year 1	Year 2	Year 3	Year 4
Density [*M(SD)*] # collaborations/all possible collaborations (range 0-1); higher=greater network cohesion and communication	.08 (.32)	.08 (.31)	.13 (.39)	.09 (.35)
Degree Centrality % of all direct collaborations involving that dept.; higher=key role in collaborations	Int Med (15.9%) Peds (15.9%) Neurol (11.4%)	Int Med (23.8%) Peds (11.9%) Biochem & Mol Bio (9.5%)	Int Med (15.2%) Peds (10.6%) Engineering (7.6%) Molecular Genetics/Micro (7.6%)	Int Med (16.7%) Pharmacy (12.1%) Pathology (9.1%)
Overall Network Centrality	12.7%	20.9%	11.4%	14.1%
Betweenness Centrality The frequency a dept. lies on the shortest path connecting all other depts.--occupies a strategic position in the network.	Int Med Peds Health, Exercise, Sports Science (HESS) Biochem/Mol Bio	Int Med Peds Molecular Genetics/Micro	Int Med Peds Molecular Genetics & Micro Engineering	Int Med Pharmacy Family & Comm Medicine
Overall Network Betweenness	12.2%	16.3%	24.3%	10.1%

Pilot Grant Collaborations – Year 1



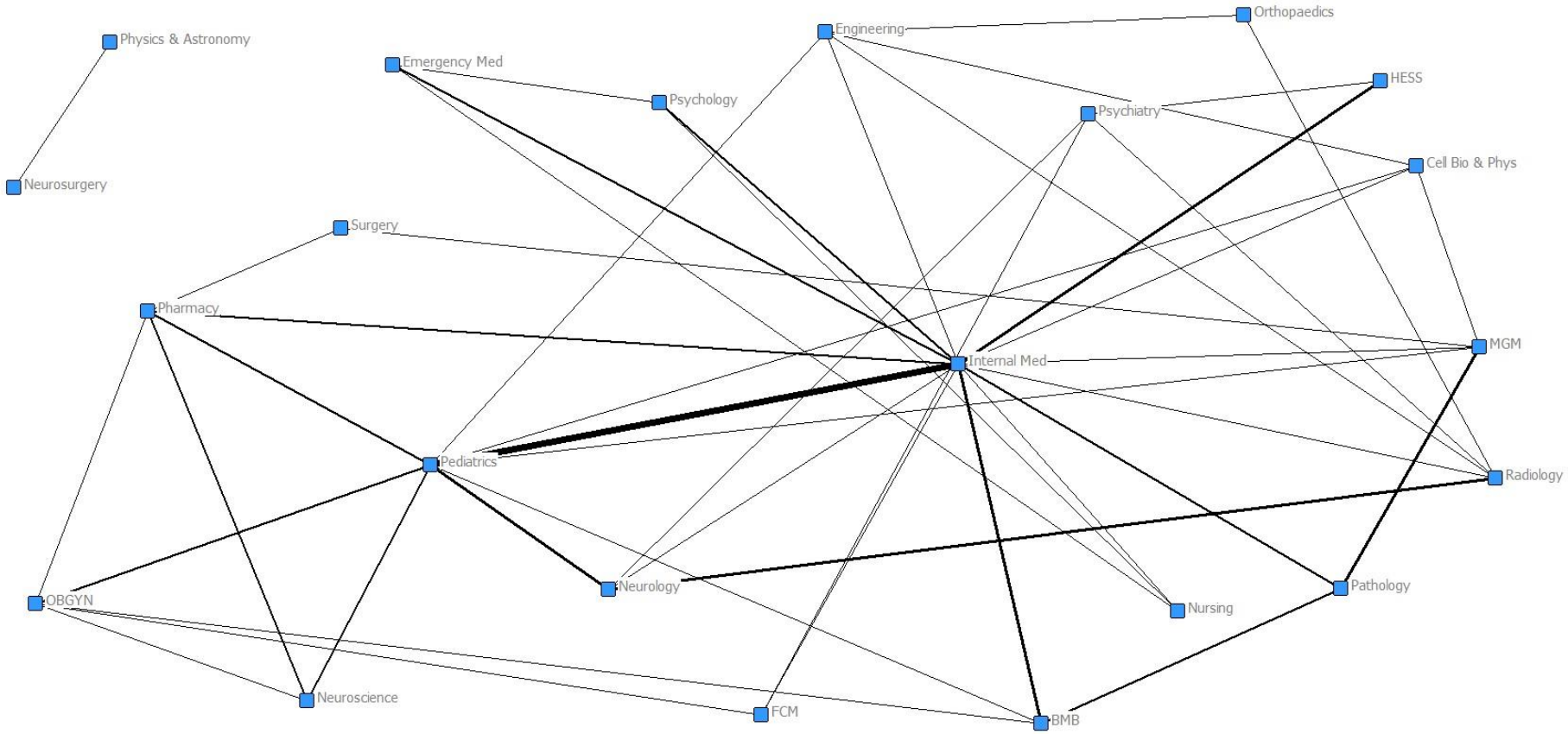
- Most collaborations were MD's collaborating with other MD's in different departments
- Internal Medicine, Pediatrics, (both largest departments/colleges) and Neurology key

Pilot Grant Collaborations – Years 1-2



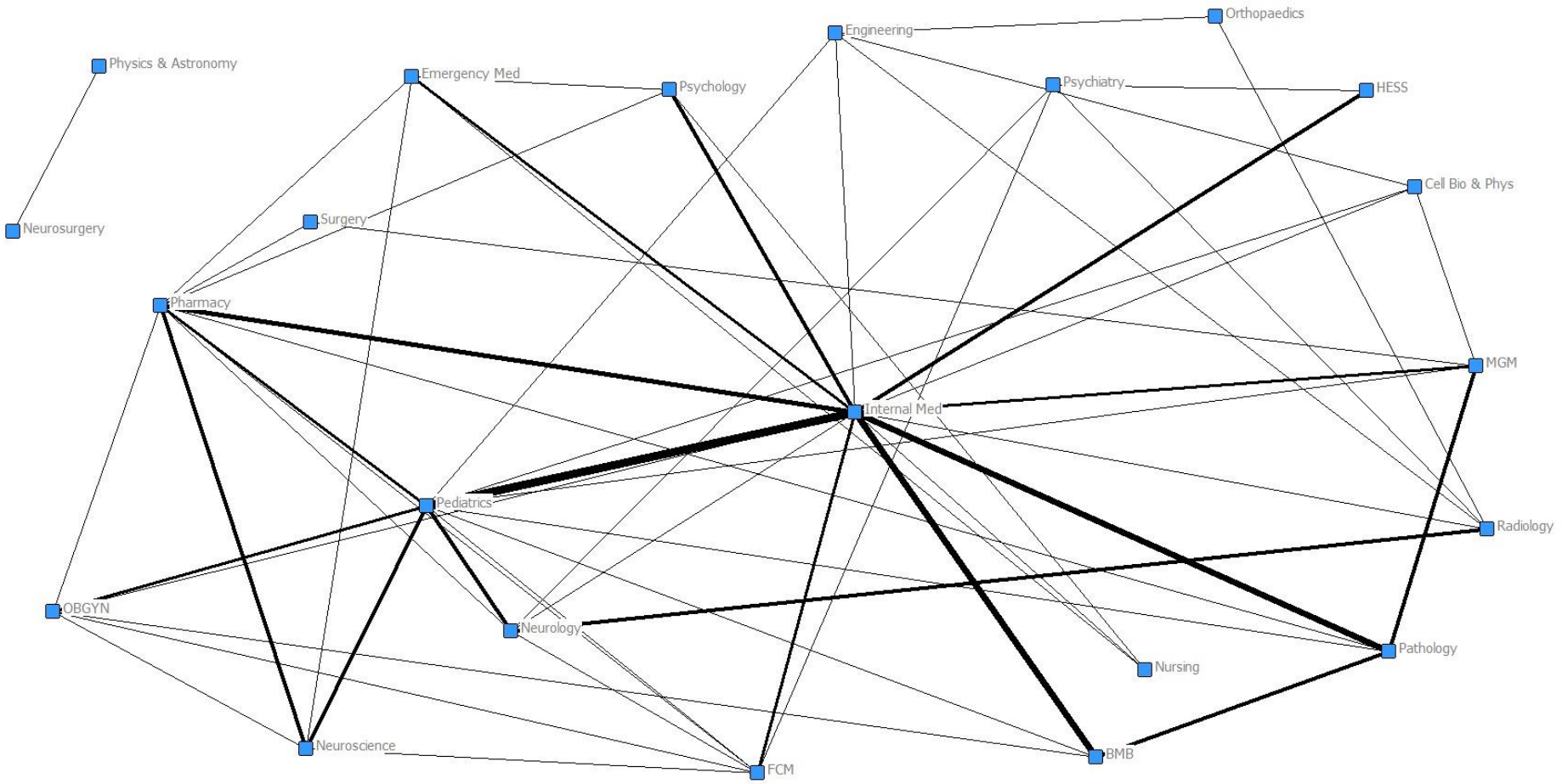
- New collaborations developed in Year 2
- Internal Medicine and Pediatrics still key; but so is Biochemistry/Molecular Biology

Pilot Grant Collaborations – Years 1-3



- Large jump in complexity of network with 40 pilots funded in Year 3
- Nursing collaborating with Internal Medicine, Psychology, and Emergency Medicine
- Engineering collaborating with Internal Medicine, Pediatrics, Orthopedics, Radiology, Cell Biology
- Pharmacy with increasing % of collaborations

Pilot Grant Collaborations – Years 1-4



- Increasing complexity of network; new collaborations not same collaborations repeated
- Internal Medicine, Pediatrics, Pharmacy, and Pathology with the most collaborations
- Internal Medicine, Pharmacy, Pediatrics, Engineering, & Radiology with most strategic positions

Summary of Measures: Stepped Cummulative Years 1-4

Network Metric	Year 1	Years 1-2	Years 1-3	Years 1-4
Density # collaborations/all possible collaborations (range 0-1); higher=greater network cohesion and communication	.08	.14	.27	.38
Degree Centrality % of all direct collaborations involving that dept.; higher=key role in collaborations	Int Med (15.9%) Peds (15.9%) Neurol (11.4%)	Int Med (19.3%) Peds (12.5%) Biochem/Mol Bio (9.1%)	Int Med (20.5%) Peds (14.4%) Neurol (6.1%) Pharm (6.1%)	Int Med (28.8%) Peds (16.7%) Pharmacy (12.1%) Pathology (9.8%)
Overall Network Centrality	12.7%	16.5%	16.6%	23.7%
Betweenness Centrality The frequency a dept. lies on the shortest path connecting all other depts.--occupies a strategic position in the network.	Int Med Peds Health, Exercise, Sports Science (HESS) Biochem/Mol Bio	Int Med Peds Ob/Gyn HESS Mol Genetics/Microb	Int Med Peds Pharmacy Engineering	Int Med Pharmacy Pedis Engineering Radiology
Overall Network Betweenness	12.2%	30.4%	38.7%	28.3%

Conclusions

- Over four years, new collaborations between investigators from different colleges and departments continued to form
- Certain colleges and departments were consistently central to the formation of those partnerships
- Social network analysis is a useful tool for researchers for depicting the structure of research collaborations
- Feedback from analyses may encourage investigators/organizations to either initiate collaboration for the first time or take a leadership role in facilitating collaboration within the institution.

UNM HSC Departments and Colleges

- School of Medicine
  - Anesthesiology & Critical Care Medicine
  - Biochemistry & Molecular Biology
  - Cell Biology & Physiology
  - Dental Medicine
  - Dermatology
  - Emergency Medicine
  - Family & Community Medicine
  - Internal Medicine
  - Molecular Genetics/Microbiology
  - Neurology
  - Neurosciences
  - Neurosurgery
  - Obstetrics & Gynecology
  - Orthopedics & Rehabilitation
  - Pathology
  - Pediatrics
  - Psychiatry
  - Radiology
  - Surgery
- College of Pharmacy
- College of Nursing

UNM Colleges or Departments

- College of Arts and Sciences
  - Department of Physics and Astronomy
  - Department of Psychology
- School of Education
  - Department of Health, Exercise, and Sports Sciences
- College of Engineering