Multilevel Perspectives on the Diffusion of Health Care Best Practices

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About Me

Communication

Organizational Networks

Health Care & Public Health
Multilevel Relationships in Health Diffusion

Industry, Environment

Organizations

Departments, Professions

Teams

Individuals
Presentation Outline

- Introduction to Multilevel Networks
- Research Example 1: Best Practice Diffusion Among Physicians & Media Artifacts in an Organization
- Research Example 2: Best Practice Diffusion Among Professionals & Organizations in a Health Care Sector
- Conclusions
Introduction to Multilevel Networks
Terminology

- **Network components**
  - Nodes: people, organizations, technologies, and other “actors”
  - Nodal attributes: e.g., demographic characteristics
  - Ties or relationships

- **Classification of networks**
  - By *mode*, or type, of node: e.g., people or organizations
    - 1-mode (unipartite), 2-mode (bipartite)
  - By types of ties
    - Uniplex, multiplex

- **Synonyms (sort of) for multilevel that are used by network scholars**
  - Multilayer
  - Multidimensional
Approaches to Analyzing Organizational Networks

- **One-mode, Inter-organizational**
- **One-mode, Interpersonal**
- **Two-mode, Affiliation**
Multilevel Research Questions

- What insights can we gain when we analyze relationships both within and between levels?
- How do relationships at one level influence relationships at another level?
- Is there structural equivalence between diffusion networks operating at different levels of analysis?
- How does knowledge diffuse across people and organizations simultaneously and sequentially?
**Example 1:** Best Practice Diffusion Among Physicians & Media Artifacts in an Organization
Objectives

1. In health care, there is much concern over 2 challenges of communicating best practices:
   - Large quantity
   - Ambiguous quality
   To what degree do these challenges actually influence diffusion?

2. How do best practices diffuse among health professionals in a network in which knowledge sources are both other professionals and media artifacts?
Empirical Context

- **Knowledge to be diffused**
  - Cholesterol treatment guidelines issued in 2013 by the American College of Cardiology and American Heart Association

- **Network nodes (or “levels”)**
  - People: 143 primary care physicians working in 17 outpatient clinics within one large medical group organization in the metropolitan US, who were both knowledge sources and knowledge consumers
  - Artifacts: 56 media artifact knowledge sources

- **Network relationships**
  - Physician-to-physician knowledge sharing ties (bi-directional)
  - Physician-to-artifact knowledge seeking ties (uni-directional)
Multilevel Model

Two-mode, Affiliation

One-mode, Intra-organizational

Physician

Physician
Theory & Hypotheses: Communication Load

- **Organizational learning theory**: Examines the learning process of organizations and their members, with particular focus on obstacles that complicate learning.

- **Communication overload**: Occurs when the high quantity/low quality of communication received differs from what is desired or hinders processing ability.

<table>
<thead>
<tr>
<th>H1: Physicians with higher communication load will be less likely to have knowledge ties with their colleagues and with artifacts.</th>
<th>Attribute-based sender (in)activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>H2: Physicians will be more likely to have knowledge ties with colleagues who act as brokers to one or more artifacts.</td>
<td>Affiliation-based popularity (brokerage)</td>
</tr>
<tr>
<td>H3: Physicians tied to artifacts will be more likely to have knowledge ties with colleagues who are also connected to those same artifacts.</td>
<td>Affiliation-based homophily (triadic closure)</td>
</tr>
</tbody>
</table>
Theory & Hypotheses: Legitimacy & Credibility

- **Institutional theory**: Proposes that organizations adopt knowledge not only for rational reasons, but also to acquire legitimacy and thus improve their chances for survival.

- **Legitimacy**: A *social* evaluation of an organization’s adherence to laws, social norms, and collective values.

- **Credibility**: An *individual* evaluation of the expertise and trustworthiness of a source.

<table>
<thead>
<tr>
<th>H4:</th>
<th>Physicians will be more likely to have knowledge ties with artifacts with greater legitimacy and credibility, and with colleagues with greater credibility.</th>
<th>Attribute-based receiver popularity</th>
</tr>
</thead>
<tbody>
<tr>
<td>H5:</td>
<td>Physicians who perceive the legitimacy and credibility of the best-practice author to be greater will be more likely to have knowledge ties with their colleagues and with artifacts.</td>
<td>Attribute-based sender activity</td>
</tr>
<tr>
<td>H6:</td>
<td>The multilevel model will explain more variance in knowledge network structure than the 1-mode model alone or the 2-mode model alone.</td>
<td></td>
</tr>
</tbody>
</table>
Methods

- **Online survey and publicly available records**
  - “List the names of physician colleagues and media artifacts from which you have learned about the guidelines”
  - Respondents: primary care physicians
  - Response rate: 71% (131/185)

- **Nodal attributes**
  - Physician knowledge sources and seekers: credibility, communication load
    - Control variables: gender, department chief status, number of hours worked per week in patient care, clinic site, tenure in organization and profession
  - Media artifact knowledge sources: legitimacy, credibility

- **Network analysis:** Exponential random graph modeling for multilevel networks in MPNet
  - 1-mode network of directed physician-to-physician knowledge ties
  - 2-mode network of physician-to-artifact knowledge ties
  - Overall network considered all nodes and ties simultaneously
Descriptive Statistics

- Negligible demographic differences between respondents and non-respondents, as assessed by multivariate analysis of variance

- Communication load: $M = 3.5 / 5.0$

- Legitimacy & credibility: $M = 5.7 – 6.3 / 7.0$

- 1-mode physician-to-physician network:
  - 43% of Rs reported knowledge ties with 65 different colleagues (35%)
  - In-degree range (knowledge source popularity): 0 – 6
  - Out-degree range (knowledge user activity): 0 – 9
  - No inter-clinic ties

- 2-mode physician-to-artifact network:
  - 85% of Rs reported knowledge ties with 56 different artifacts
  - Physician degree range: 0 – 7
  - Artifact degree range: 1 – 41 ($M = 4.5$)
  - Most popular artifacts: *UpToDate*, medical publications, mass media newspapers
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Est.</th>
<th>SE</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>ArcA</td>
<td>-14.1716</td>
<td>(1.583)</td>
<td>*</td>
</tr>
<tr>
<td>ReciprocityA</td>
<td>3.5373</td>
<td>(0.684)</td>
<td>*</td>
</tr>
<tr>
<td>TwoPathA</td>
<td>-0.2356</td>
<td>(0.108)</td>
<td>*</td>
</tr>
<tr>
<td>SinkA</td>
<td>2.2492</td>
<td>(0.441)</td>
<td>*</td>
</tr>
<tr>
<td>AoutSA</td>
<td>0.5649</td>
<td>(0.247)</td>
<td>*</td>
</tr>
<tr>
<td>Chief_SenderA</td>
<td>1.1083</td>
<td>(0.319)</td>
<td>*</td>
</tr>
<tr>
<td>Chief_ReceiverA</td>
<td>1.6516</td>
<td>(0.391)</td>
<td>*</td>
</tr>
<tr>
<td>Gender_ReceiverA</td>
<td>-1.0522</td>
<td>(0.423)</td>
<td>*</td>
</tr>
<tr>
<td>Gender_InteractionA</td>
<td>1.0462</td>
<td>(0.425)</td>
<td>*</td>
</tr>
<tr>
<td>Physician Credibility_ReceiverA</td>
<td>1.2515</td>
<td>(0.165)</td>
<td>*</td>
</tr>
<tr>
<td>XEdge</td>
<td>-4.9476</td>
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<td>*</td>
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<tr>
<td>XStar2B</td>
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<tr>
<td>XASB</td>
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<td>(0.029)</td>
<td>*</td>
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<tr>
<td>Out2StarAX</td>
<td>0.1099</td>
<td>(0.046)</td>
<td>*</td>
</tr>
<tr>
<td>ACC Legitimacy_SenderA</td>
<td>0.5178</td>
<td>(0.165)</td>
<td>*</td>
</tr>
</tbody>
</table>
Conclusions

- Contingent nature of communication load effects on knowledge networks
- Importance of legitimacy of organizational authors of best-practice knowledge
- Potential of research on multilevel knowledge networks
Example 2: Best Practice Diffusion Among Professionals & Organizations in a Health Care Sector
Objectives

- Assess similarities and differences between inter-organizational and interpersonal advice networks in the long term care sector, and the relationship of these networks to one another.
- Are predictors of tie formation the same or different in the two types of networks?
- Is there structural equivalence in the roles and positions in the two networks (e.g., do opinion-leading individuals work in opinion-leading organizations)?
- Why may it be important for decision-makers to understand the structure of both networks?
Empirical Context

- Knowledge to be diffused
  - Advice about care improvement and innovation in residential long term care sector in Canada (all provinces/territories except Ontario & Quebec)

- Network nodes (or “levels”)
  - People: 1,140 senior professionals in long term care
    - 652 directors of care/nursing working in LTC facilities
    - 488 senior leaders working outside a facility (in corporate level of LTC provider organization, regional health authority or government ministry, or external expert (clinical specialist, educator, etc.)
  - Organizations: 792 LTC facilities

- Network relationships
  - Interpersonal senior leader-to-senior leader advice ties (bi-directional)
  - Inter-organizational facility-to-facility advice/social influence ties (bi-directional)
Multilevel Model

LTC Facility

One-mode, Inter-organizational

Individual

One-mode, Intra-organizational or Interpersonal

Individual

LTC Facility
Methods

- **Online survey of directors of care and administrative records**
  - “Name 3 individuals/3 nursing homes whose advice/example you most value about delivery of quality care, care improvement, and innovation”
  - Respondents: directors of care working on LTC facilities
  - Response rate: 51%

- **Nodal attributes**
  - Senior leaders: gender, organizational role/position
  - LTC facilities: ownership model (public, private, etc.), number of beds
  - Both types of nodes: geographic location (province, health authority)

- **Network analysis: exponential random graph modeling in statnet, additional analysis TBD**
  - 1-mode network of directed interpersonal advice ties
  - 1-mode network of directed organizational advice ties
  - Comparison of two networks
## Descriptive Statistics

<table>
<thead>
<tr>
<th></th>
<th>Inter-organizational</th>
<th>Interpersonal</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>N nodes</strong></td>
<td>792</td>
<td>1140</td>
</tr>
<tr>
<td><strong>N ties</strong></td>
<td>1230</td>
<td>1181</td>
</tr>
<tr>
<td><strong>N (%) inter-provincial ties</strong></td>
<td>61 (5%)</td>
<td>30 (3%)</td>
</tr>
<tr>
<td><strong>Density (M [SD])</strong></td>
<td>.037 (.038)</td>
<td>.016 (.017)</td>
</tr>
<tr>
<td><strong>In-degree centralization (M [SD])</strong></td>
<td>.11 (.08)</td>
<td>.08 (.06)</td>
</tr>
<tr>
<td><strong>N opinion leaders</strong></td>
<td>39</td>
<td>50</td>
</tr>
<tr>
<td><strong>N boundary spanners</strong></td>
<td>50</td>
<td>51</td>
</tr>
</tbody>
</table>
Comparing Interpersonal & Inter-organizational Networks: Manitoba
Research Team

Funders: CIHR, Alberta Innovates Health Solutions, Michael Smith Foundation for Health Research, Nova Scotia Health Research Foundation, Research Manitoba

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Decision Makers: Carol Anderson, Marian Anderson, Karen Bloemink, Debra Boudreau, Marlene Collins, Lorraine Dacombe Dewar, Heather Davidson, Yvette Deleff, Hana Forbes, Jodi Hall, Heather Hanson, Cheryl Holt, Victorine Lafferty, Lori Lamont, Don McLeod, Cathy Morton-Bielz, Leanne Rein, Linda Resteau, Eleanor Risling, Perry Sankarsingh, Corinne Schalm, Irene Sheppard, Gina Trinidad

Trainees: Amanda Beacom, Stephanie Chamberlain, Lauren MacEachern, Erin McAfee
Conclusion
Concluding Thoughts

Applying multilevel perspectives to analyze diffusion networks in health care allows for

- Conceptualization of nodes and ties in novel ways
- Better representation of the complex relationships, dependencies, and interactions that occur in real-life diffusion processes
Suggested Readings & Resources

Software

- rSiena: stochastic actor-oriented models for longitudinal data
- MPNet: exponential random graph models for cross-sectional data
- Relational event models in R

Journal Special Issues


Books

Thank you

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