MEDINFO23
8 – 12 JULY 2023 | SYDNEY, AUSTRALIA

Analyzing patient-sharing network using an administrative claim database in Japan

Tomoki Ishikawa
Senior Researcher
Institute for Health Economics and Policy, Japan

Patient-sharing/medical coordination in Japanese

- Local government mandated to develop strategies by Medical Law
- complicated to understand Real-World sharing status
- high liquidity, due to free-access system and free to open medical office

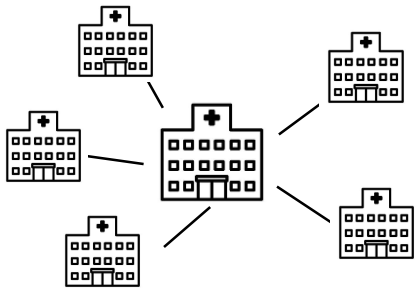
To propose effective policy based on evidence, we should

- *Visualize* sharing structure
- *Monitor* the patient/provider behavior over time
- *Evaluate* quantitatively

Issue: Absence of a framework for analyzing healthcare coordination networks

What remains unknown

Issue1: Absence of data to analyze linkages



What data is available?

Issue 2: Absence of methods and indicators

What methods is applicable?

Issue 3: Integrated verification of available data and methods

Purpose : To propose a method framework to assess the overall sharing network

Our developing concept

Transformation into graph structure

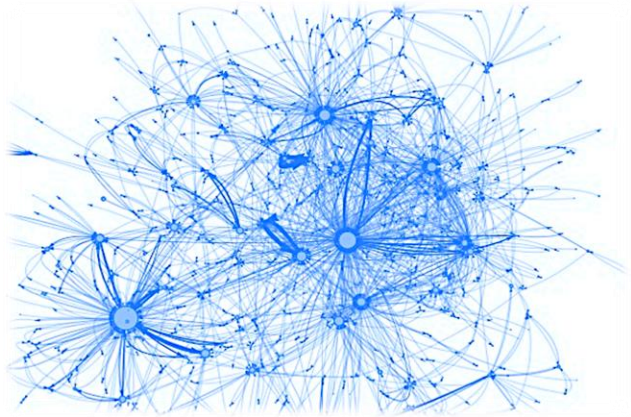
Data source : Administrative claims database

Public health insurance claims data
(Historical information on medical practice)

- Patient character
- Facilities information
- Diagnosis
- Prescription
- Treatment procedure

Overlay individual graph

Creation of a sharing network model



This model allows

- Visualization of network structure and position of each facilities
- Calculation of structural indicators for the entire network
- Evaluation of the importance of each facilities in the network

Methods

Data coverage

- September of each year from 2018 to 2021

Patients

- With hypertension by confirmed diagnosis record (ICD10: I10-I15)

Patient sharing network

- Case that patient visits multiple medical facilities for the same disease.
- Facilities were defined as nodes in the network graph.
- Paired facilities were considered to have links (i.e. edges).
- Links are considered directed.

Variable Outcome | Network structure indicators

Density: Proportion of the actual edges to all possible edges in a network.

$$density = \frac{2m}{n(n-1)}$$

n: number of nodes
m: number of edges

Reciprocity : Proportion of mutual edges to all directed edges which a member has mutual connections to another nodes

$$reciprodcity = \frac{a}{a+b+c}$$

a: Number of edges in both directions
c,d: Number of edges in one direction

Variable Outcome | Provider-level indicators

Degree

- the number of links on a node in a network
- frequency of collaboration in a network

Betweenness centrality:

- how influential a node is in maintaining a network structure
- A node with high betweenness centrality means that the node tends to exist on many shortest paths between other pair of nodes in a network.

Page Rank:

- how importance of the node to which it is connected, taking into account its centrality.

Results | Visualization of network graph

September 2018

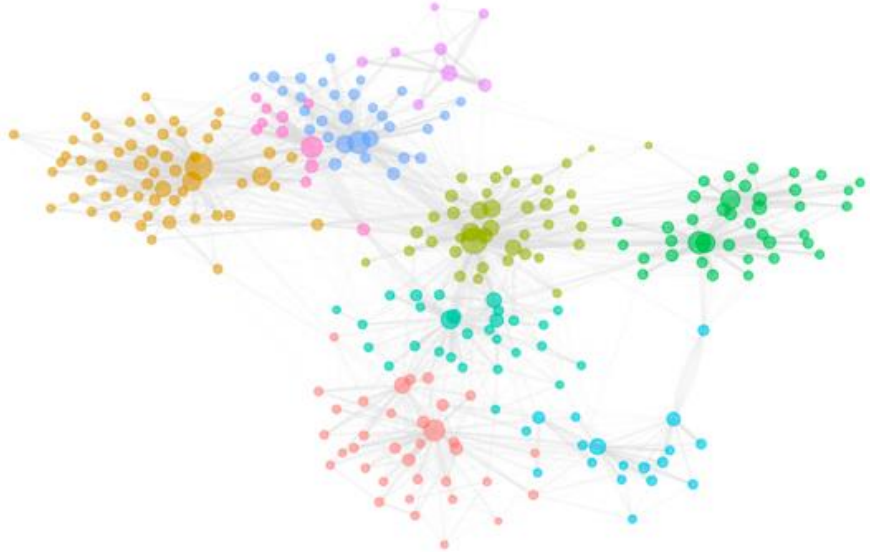
*The location of node is not reproducible due to random determination

Results | Clustering of network graph

September 2018

Number of clusters: 9

September 2021



Number of clusters: 9

*The location of node is not reproducible due to random determination

Results | Patients/facilities characteristics

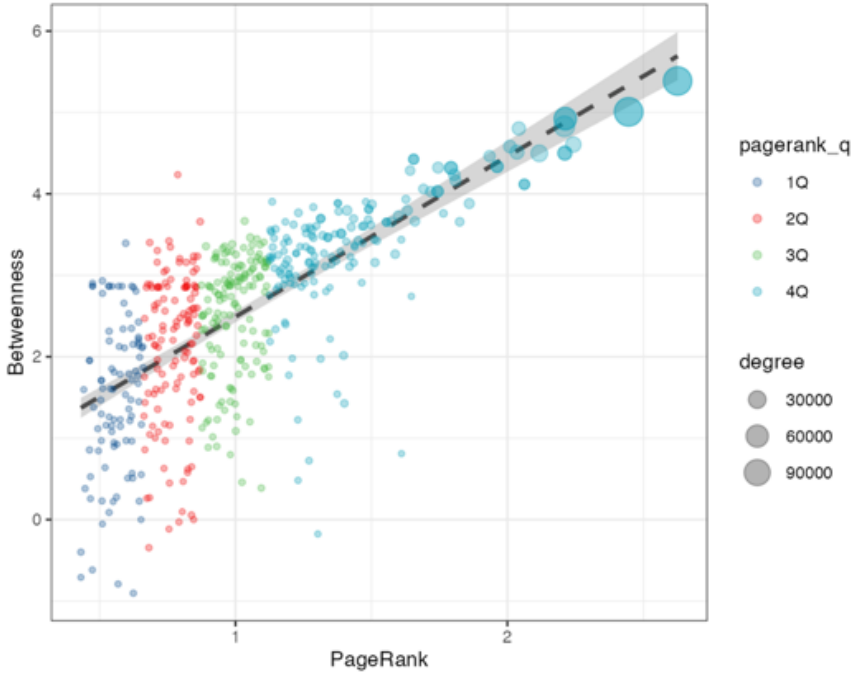
Patients Characteristics	2018	2019	2020	2021
n, visit	70,559	71,421	68,411	65,794
n, visit multiple facilities	11,352	11,833	11,582	11,438
Proportion of Shared Patients (%)	**16.10%**	**16.60%**	**16.90%**	**17.30%**
Age, mean (SD)	78.1 (8.7)	78.5 (8.6)	78.4 (9.0)	78.5 (8.9)
Sex, Female (%)	6,090 (53.6%)	5,402 (45.7%)	5,466 (47.2%)	6,026 (52.7%)

Facilities	2018	2019	2020	2021
n, Facilities	**1,685**	**1,649**	**1,563**	**1,492**
Bed, mean (SD)	172.3 (211.7)	164.5 (202.6)	172.8 (207)	172.6 (207.2)

Results | Network indicators

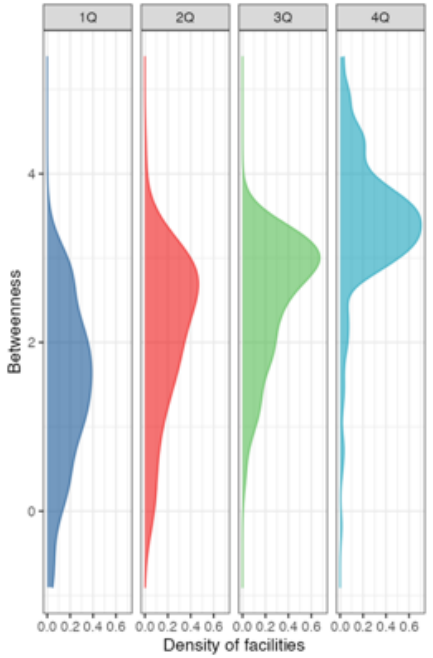
Network indicators	2018	2019	2020	2021
Density	5.23×10^{-2}	5.81×10^{-2}	6.12×10^{-2}	6.13×10^{-2}
Reciprocity	4.39×10^{-1}	5.12×10^{-1}	6.07×10^{-1}	6.51×10^{-1}
Transitivity	7.09×10^{-2}	7.53×10^{-2}	8.32×10^{-2}	8.37×10^{-2}

Results | Bubble chart between three indicators in 2021



Groups divided by PageRank(PR) quartile

Low PR← →High PR



Findings from Big patient sharing network graph

- **Health policy perspective:** Grasping the structure of medical collaboration
  - determination of the unit of medical coordination
  - Identification of a facility that is a "hub" of the collaboration
- **Medical institutions:** understanding their position/role for medical collaboration

Findings from evaluations by indicators of network structure

- **Decrease** facilities involved in collaboration **Increase** demand for medical collaboration
- **Increase density:** The combination of facilities is becoming more diverse and strengthened
- **Increased reciprocity:** More and more facilities are sharing patients with each other.

Association of Indicators (Betweenness/PageRank)

Facilities groups with lower PR

- High variance betweenness centrality
- Some facilities are frequently involved in collaboration, but are not reflected in the importance
- Possibly considering other factors besides just the amount of patient flow.

Further analysis

Lower PageRank would provide a more detailed understanding of the

Limitation: accuracy of identifying medical linkages

- Difficulty to strictly separate collaboration from multiple consultations by patients
- Japanese Additional fees for reimbursement system to ensure accuracy.
- Receipt data not proposed diagnosis information regarding to collaboration

Future Study Prospects

- Application other disease: possibility to ensure specific disease
  - (e.g., stroke, cardiovascular diseases)
- Application to policy related to various collaboration and patient behavior
  - acute treatment and long-term care coordination,
  - family doctor/ general practitioner