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**CONFERENCE ABSTRACT****Complex Networks Theory Building for Integrated Healthcare Research in Rural China**17<sup>th</sup> International Conference on Integrated Care, Dublin, 08-10 May 2017

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**Introduction:** The three tiered healthcare networks (county, township and village) in rural area of China undertakes health service needs of 0.8 billion rural residents. Multiple researches in this area indicates the healthcare system in rural area is suffering from lacking integrated networks not only among healthcare institutions, but also among all the participants from different interest related parties, this current situation causes numerous issues in rural healthcare system including huge waste of healthcare resources, overuse and misuse of medication between different tiered institutions and gaps of medical information transferring and sharing during the referral processes, etc. However, the traditional models and methods for healthcare system analysis usually not enough to elaborate the specific networks among all of participants in this system and to monitor the changing of the overall networks. We introduced the Complex networks theory into this area and try to build a new analysis aspect for future study of integrated healthcare researches.

**Method:** This study simulated and analyzed the characteristics of Complex networks system in rural area of China by introducing the Small world and Community structure theories from System Science. We designed a hypothetic complex networks environment of rural healthcare system with participants (Nodes=200), connectivity ( $K=15$ , means the average number of edges connected to a node), and  $\beta=0.15$  which indicates the possibility of connection of each participant.

**Result:** In simulated environment of healthcare system in rural area, the Clustering coefficient (which measures the density of triangles in a networks) is high and the Scale-free Property (which refers to any functional form  $f(x)$  that remains unchanged to within a multiplicative factor under a rescaling of the independent variable  $x$ ) is quite obvious (Graph 1.). Furthermore, the result also indicates that the networks of rural healthcare system shows the "Community structure" which means the groups of vertices that have a high density of edges within them, with a lower density of edges between groups. (Graph.2.)

Graph.1. The small world effect and Scale-free Property

Graph.2. The Community structure

**Conclusions:** We presume that the small world Effect, Scale-free Property and the Community structure does exist in interpersonal networks in rural healthcare system, it indicates that in an actual environment of rural healthcare system, the providers and users consisted millions of nodes, and most of these nodes only contact with their neighbors or acquaintances. At the same time, most of rural areas in China has no initial diagnosis or "Gate keeper"-General practice system at present, so service users could freely reach to any providers who has high professional position or good reputation in that area.

**Discussion:** This study was inspired by the innovative works in complex theory studies in recent years. We could use the theories from complex networks such as Small world and Community structure to simulate and to analyze the healthcare networks in rural China in order to find more specific characteristics among the integrated networks in rural area. For example, by analyzing the actual networks based on Small world theory, we could locate the high density "community" (it could be an institution or a physician) in networks and precisely change the healthcare resource structure to make the system more integrated.

**Lessons learned:** The Complex Networks theory is rarely used in the area of Integrated Healthcare studies, we learned that when building the model of Small world by Matlab, it should be very carefully to avoid the characteristic difference between the healthcare networks and other networks.

**Limitation:** Because of data limitation, we could not use the actual interpersonal networks data for modeling, just simulated the modeling process to report the practical significance for using this theory to analyze the integrated healthcare system in rural area.

**Suggestion for future research:** This study is trying to introduce an essential theory into integrated healthcare networks study. However, the stage for now is just in the process of simulating a hypothetical environment. Actually, at present, our research team launched a big data healthcare research project in Yichang, Hubei province, China. We are trying to analyzing the networks of Yichang region which contains millions of resident information by using Complex networks theory which mentioned in this paper.

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**Keywords:** complex networks; rural healthcare; integrated

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