Social-Network Analysis for Pain Medications: Influential physicians may not be high-volume prescribers

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Introduction

Social Network Analysis in Medical Domain

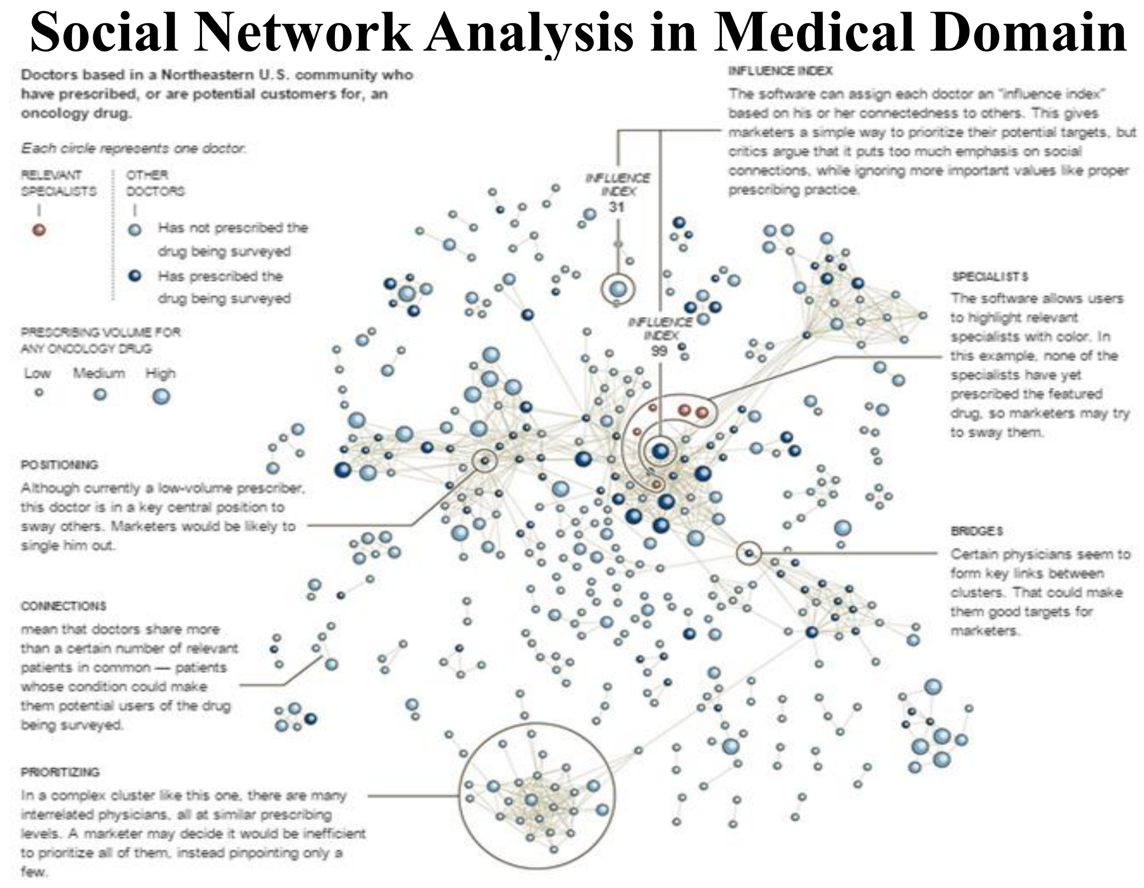

Fig. 1. The figure shows doctors based in a Northeastern U.S. community who have prescribed or are potential customers for an oncology medicine. Source: www.nytimes.com

Objective*: To study how social network analysis and prescribing histories could be used for finding relationships among doctors, and for pinpointing highly connected "critical" physicians*

- Globally, it has been estimated that 1 in 5 adults suffer from pain and that another 1 in 10 adults are diagnosed with chronic pain each year (International Association for the Study of Pain)
- According to the Committee on Advancing Pain Research, Care, and Education, 100 million Americans suffer from chronic pain more than diabetes, heart disease, and cancer combined
- Adoption of pain medications for pain management and safe healthcare practices is a major global policy concern

Background

- The rate of adoption of a new product varies from individual to individual (Valente, 1996)
- The diffusion of innovation is the process by which a few members of a social system initially adopt an innovation, then over time more individuals adopt until all (or most) members adopt the new idea (Ryan & Gross, 1943; Rogers, 1983; Valente, 1993)
- The diffusion of innovations and adoption of new professional practices in the healthcare field are influenced by interpersonal interactions (Mahajan, Muller & Srivastava, 1990)
- Lewis (2006) used nomination study to create a social network to examine the influence of medical profession in the health policy arena
- Keating (2007) used a survey approach to create network of influence among primary care physicians in a hospital practice
- Creswick and Westbrook (2010) conducted a study in the renal ward of an Australian metropolitan teaching hospital. They designed a social network questionnaire containing five social network questions about each person in the ward

Data

Health Database

- Physician's dataset (80,000+): contains physician's geographical data, specialty etc.
- Prescription and sales dataset (1 billion): contains every physician's prescription history

Affiliation Database

- Business dataset (1 million): contains hospital affiliation and hierarchy data
- Physician's affiliation dataset (3.2 million): contains data regarding affiliation of physicians' to different Health center's

Medication Duration: January-2011-March 2016

Method

Assumptions for building the social networks:

- Working in the same hospital
- Same specialty
- Same Specialty group (similar specialties are clustered into groups)

Assumptions for creating the Directed Influence graph

- Pain medication prescription
- Time of adoption

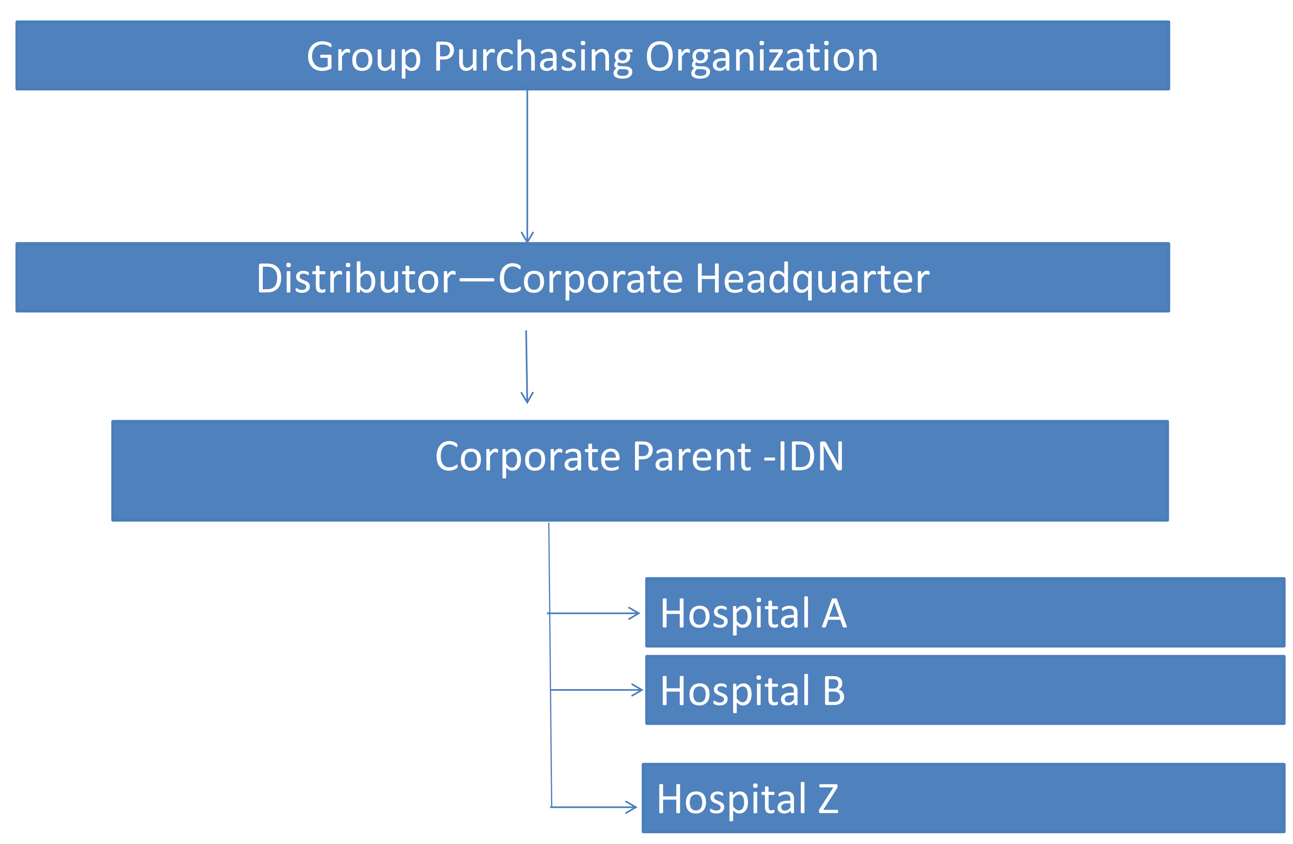

Fig. 2. Hierarchy of Hospitals in USA

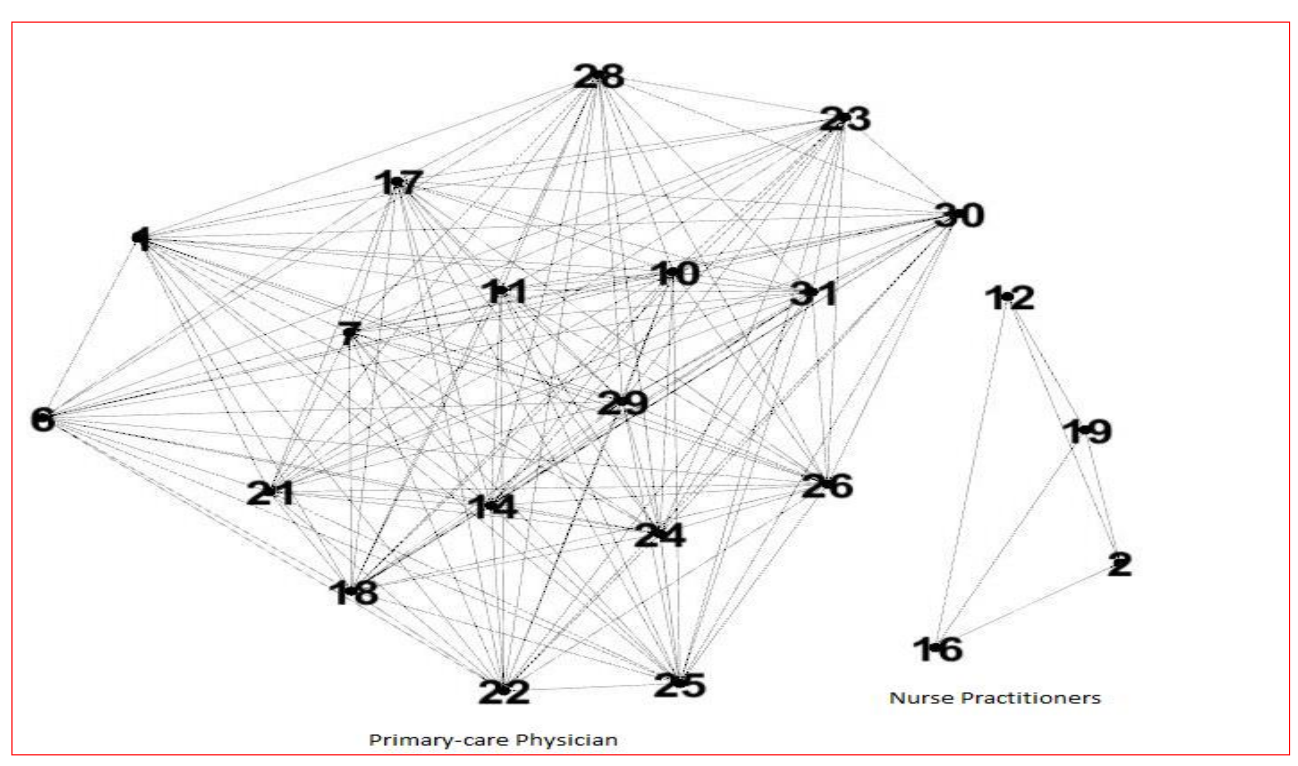

Fig. 3. Directed Influence graph between different prescribers of pain medication. The numbers associated with each node are the identification number of each physician. Two isolated clusters of specialty group (PCP and Nurse Practitioner) are visible

Results

1. **Physicians from specialty internal medicine and family medicine i.e. Primary care Providers had the highest in-degree centrality within the IDN**
2. **Neurology and nurse practitioners were the ones prescribing the highest volumes of medication within the IDN**
3. **Females physicians (mostly nurse-practitioners) were prescribing higher volume of scripts compared to male physicians**

Limitations

- Single Integrated Delivery Network (IDN) located in Massachusetts, USA
- One pain medication for creating the directed Influence graph
- In addition, we also assumed that a physician prescribing a pain medication before other physicians in their social network would influence these physicians in their social network with certainty

Future Scope

- We plan to improve our assumptions by considering multitude of IDNs consisting of several physicians over several hospitals prescribing several pain medications
- Using referral patterns, author-coauthor relationship for creating the social network
- Furthermore, we also plan to improve our diffusion of innovation assumptions by parameterizing the diffusion process using a probability as well as by considering other data that indicates stronger diffusion possibilities in the network

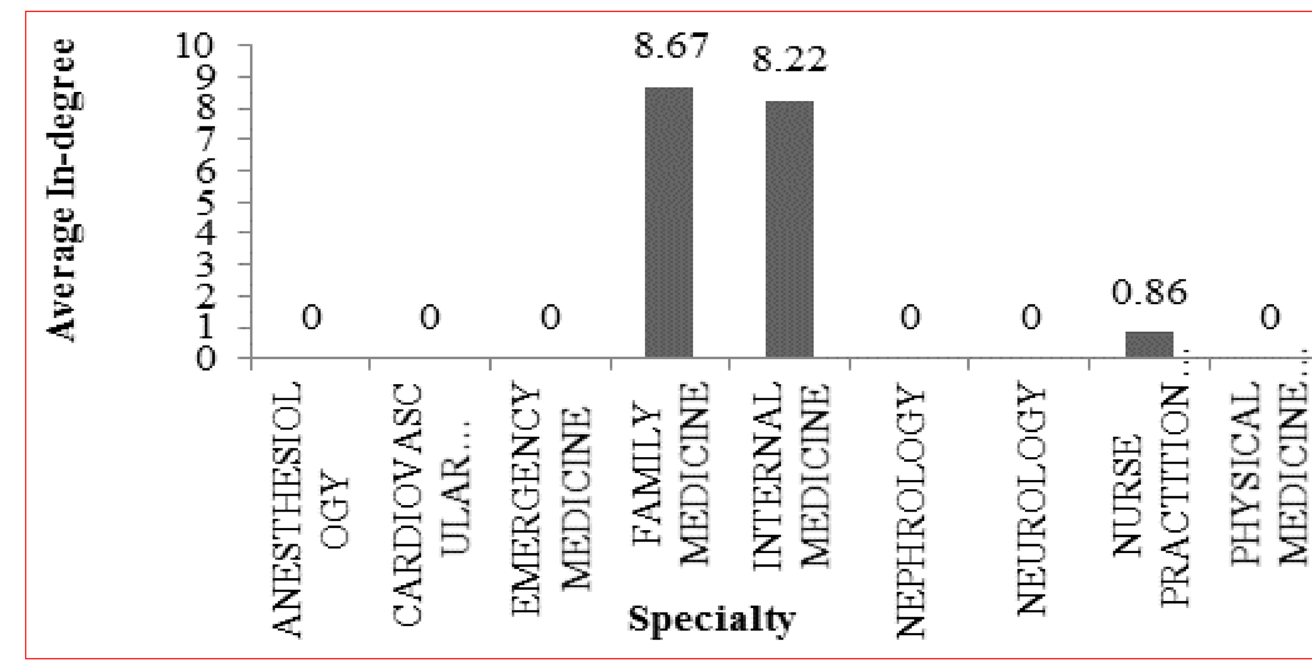

Fig. 4. Average In-degree for different specialties

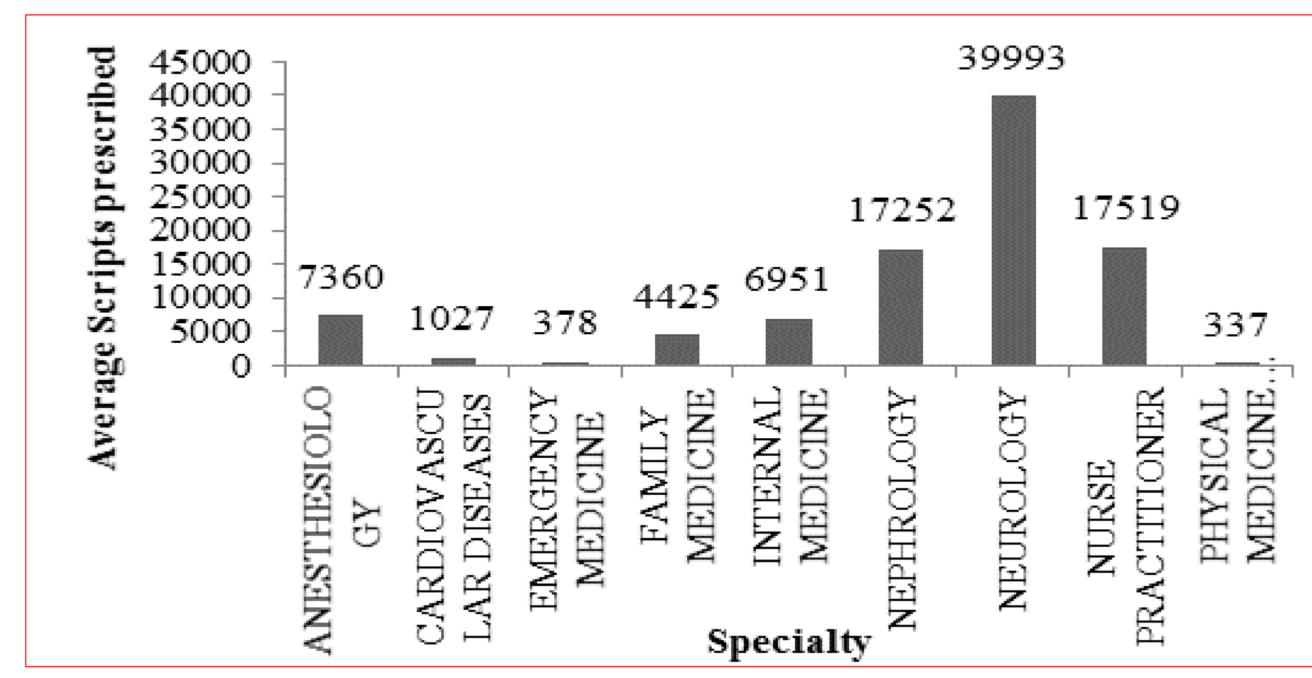

Fig. 5. Average number of scripts prescribed for different specialty

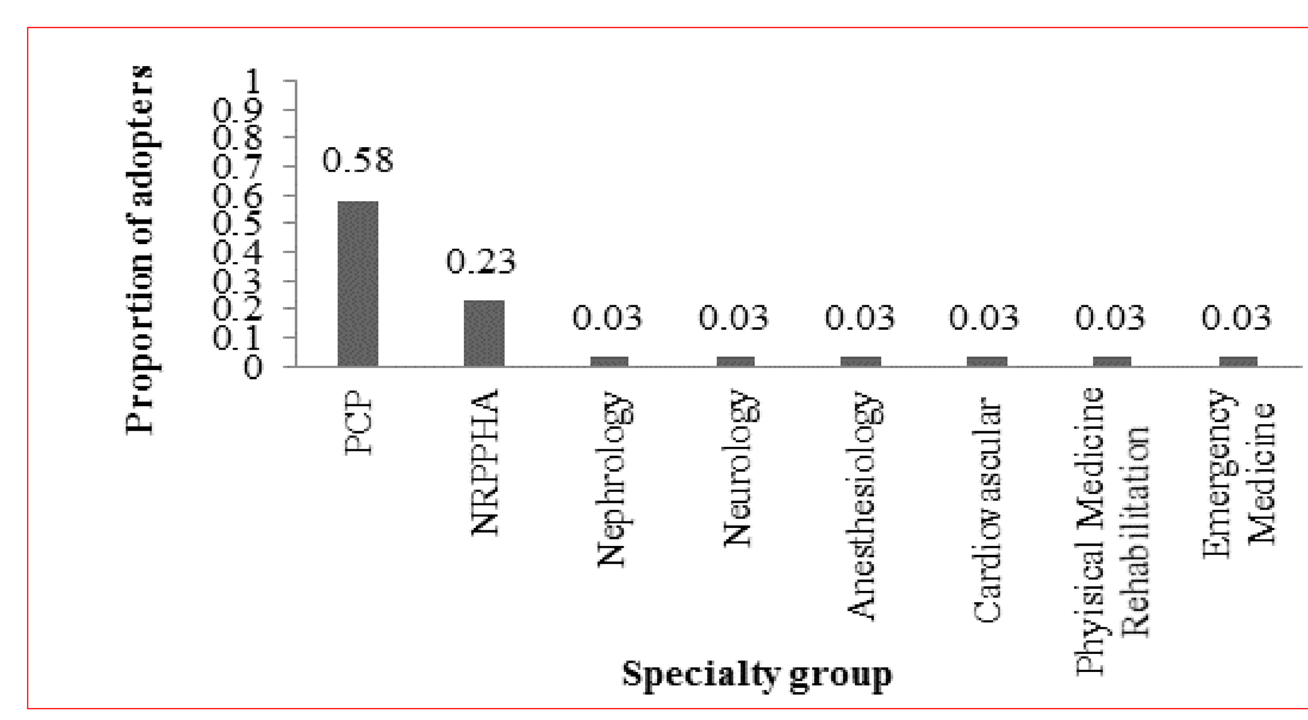

Fig. 6. Proportion of physicians adopting medicine M from different specialty group

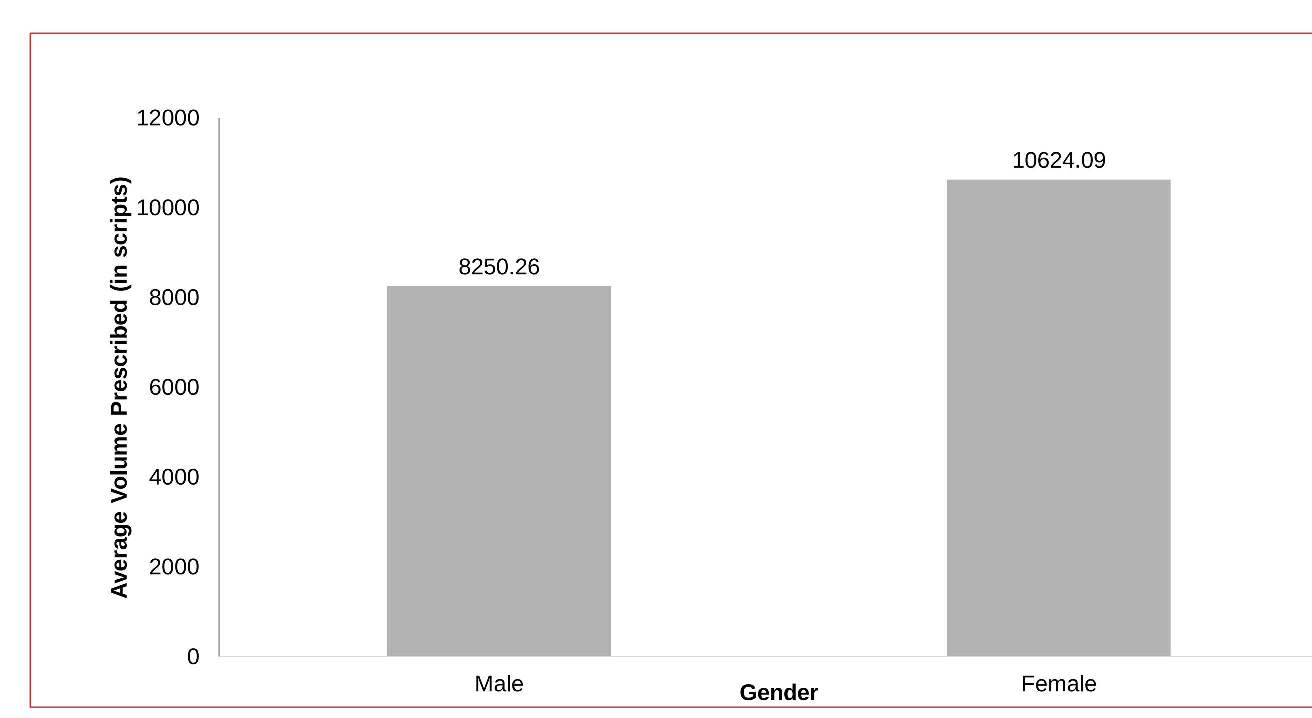

Fig. 7. Average number of scripts prescribed for different gender

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