

# *Research on the Increasing Law and Authors Distribution of Medical Records Management Literature in China*

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**Abstract**—Based on literature growth model and Lotka's law in informetrics, this thesis targets at medical records management literature from China National Knowledge Infrastructure (CNKI), researches on their growth from 1956 to 2015 to find a two-phase linear growth model. Meanwhile, maturity of medical records management is concluded from analysis of relevant authors. Generally, China's medical records management is heading to further development but still remain in earlier stage, in which author group expands and prefer collaboration in paper presentation, while researches are not mature.

**Keywords**—*medical records management; literature growth pattern; Lotka's law; author analysis*

## I. INTRODUCTION

With further development of medical system reform, growth on population with medical and commercial insurance and enhanced legal consciousness, medical records, the source and evidence for cases, are gradually brought to the forefront. Office of medical records management serves as a potential window due to increasing medical record referring and printing<sup>[1]</sup>. Researchers are key elements for promoting science development. By researching on their quantity and working pattern, people can notice influential authors, rate scientific productivity, clear researches structure and distribution, finally predict authors' growth as well as scale and trend of science development<sup>[2]</sup>. Analyzing on medical records management literature, relevant authors' quantity and research teams' current development, this thesis will present China's current situation in medical records management and provide reference advices for its healthy and sustainable development.

## II. DATA RESOURCE AND METHODOLOGY

### A. Data Resource

Based on China National Knowledge Infrastructure (CNKI), the research team acquired 8,742 satisfactory literatures over 60 years (1956-2015) after filtration.

### B. Methodology

The research team analyzes growth pattern of medical records management literature with literature growth model while requery and distribution pattern of qualified literature authors is measured with Lotka's law in informetrics.

## III. ANALYSIS ON LITERATURE GROWTH PATTERN

### A. Basic situation of document growth

As a main record carrier of medical cases, medical records management literature's quantity growth is a significant indicator to directly reflect medical cases' development and trend. TABLE I illustrates anual number, year-on-year growth and total quantity of medical records management literature from 1956 to 2015.

TABLE I. MEDICAL RECORDS MANAGEMENT LITERATURE FROM 1956 TO 2015

Year	Number	Year-on-year Growth	Total	Year	Number	Year-on-year Growth	Total
1956	1	0	1	1997	293	166	1073
1965	2	2	3	1998	138	-155	1211
1979	1	1	4	1999	122	16	1333
1981	5	4	9	2000	184	62	1517
1982	5	0	14	2001	434	250	1951
1983	11	6	25	2002	451	17	2402
1984	1	-10	26	2003	557	106	2959
1985	4	3	30	2004	573	16	3532

Cont. to TABLE I							
1986	4	0	34	2005	459	-114	3991
1987	6	2	40	2006	638	179	4629
1988	9	3	49	2007	478	-160	5107
1989	8	-1	57	2008	448	-30	5555
1990	10	2	67	2009	479	31	6034
1991	8	-2	75	2010	475	4	6509
1992	19	11	94	2011	497	22	7006
1993	20	1	114	2012	437	-60	7443
1994	75	55	189	2013	445	8	7888
1995	464	389	653	2014	450	5	8338
1996	127	-337	780	2015	404	-46	8742

The literatures growth indicates that its quantity varies with time, which reveals characteristics and patterns of subject development. TABLE I shows a slow growth of literatures before 1993 with an annual average growth of 3 and reached a peak of 20. Since 1994, increasing attention brought literatures an annual growth of 392.2 and the fastest growth came in 2016, with 638 literatures in one year.

B. Literature Growth Model

Based on the relation of time and total literature quantity, the research team can draw curve of scatter plots as Fig.1.

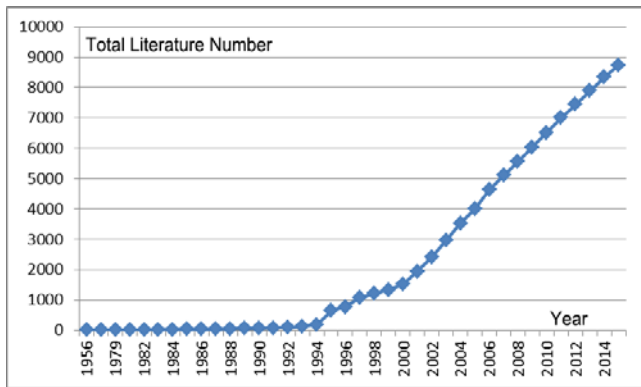


Fig. 1. Quantity Curve of Medical Records Management Literature 1956-2010

Fig. 1 shows literature quantity before 1993 is too small so the research team conducts regression analysis on data from 1994 to 2015. After linear and exponential fitting in SPSS, the team acquires model parameters and curve in Fig.2 ( $R^2=0.983$  in the linear,  $R^2=0.899$  in the exponential). The curve shows higher relevancy degree in linear fitting, which means growth trend between 1994 and 2015 is more approximate to linear growth model.

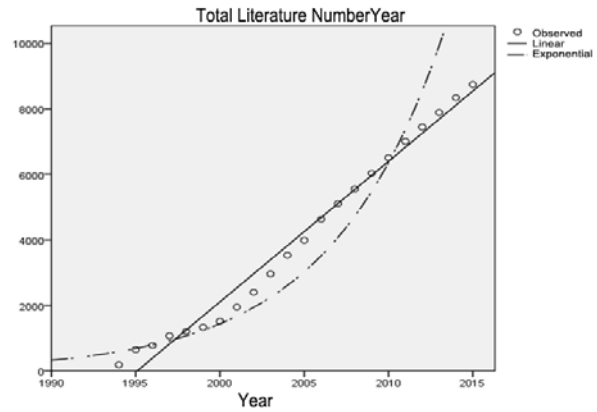


Fig. 2. Growth Fitting Curve of Medical Records Management Literature

C. Analysis on Development Stages of Medical Records

China’s medical records management started in 1921, the same time with Peking Union Medical College Hospital’s establishment. The development medical records management can be divided into two phases according to analysis above [3].

The first stage is from 1921 to 1993, a period with low literature publication level of medical records management, and the only one article- “Improve Medical Records Quality, Manage Relevant Work Well” was published in 1956.

The second stage is from 1994 to recent days. In 1994, the ministry of health released *Detailed Rules for Administration of Medical Institutions*, in which stipulate clinic records being on file for at least 15 years while hospitalization record for at least 30 years. Peking University Health Science Center started undergraduate course of medical information management in 2002, while the ministry of health and state administration of traditional Chinese medicine published *Chinese Medical Record* in the same year. In this process, medical records have aroused attention from the public and government so that rules and laws were introduced in succession, leading to a gradual increase of medical record management literatures.

IV. ANALYSIS ON GROWTH PATTERN OF LITERATURES

A. Annual Number of authors

According to the statistics, there are 9410 authors of medical records management literature in total with 17691 person times. Due to slow growth from 1956 to 1993, this period is regard as one statistical year. Author quantity in different years is showed below in TABLE I. Personal number of published articles can be worked out with the total number of articles and authors [4]. It is demonstrated that average number is less than 1 article per person.

TABLE II. AUTHOR QUANTITY FROM 1956 TO 2015

Year	Number of Author	Person Time	Total Publication	Average Publication
1956-1993	195	207	114	0.58
1994-1997	1333	1710	959	0.72
1998-2001	1236	1700	878	0.71
2002-2005	2334	3742	2040	0.87
2006-2009	2666	4183	2043	0.77
2010-2013	2828	4071	1854	0.65
2014-2015	1601	2078	854	0.53

B. Annual Analysis on Coauthor

Degree and rate of cooperation varies from subject characteristics when high value means stronger cooperation trend with obvious subject cross. Formula: Cooperation Degree= Author Number/ Article Number (in certain periodical period); Cooperation Rate= Cooperation Article Number/ Total Article Number \* 100% [5].

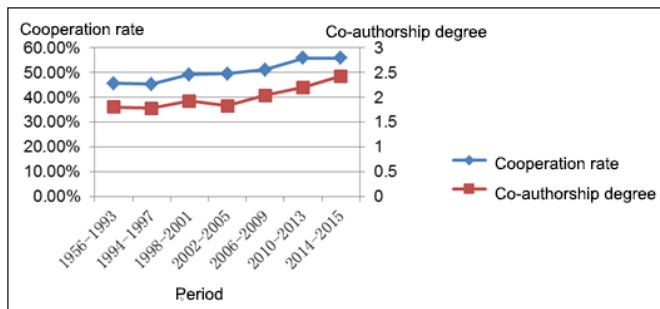


Fig. 3. Annual Cooperation Degree Cooperation Rate

Fig.3 illustrates an increasing cooperation degree that at least 2 persons write in collaboration with each other for one article annually, with the highest record of 2.43 persons from 2014 to 2015, indicating growing cooperation in medical records research and more communication between researchers.

C. Lotka Fitting Analysis

Lotka's Law describes the distribution of authors in informetrics. The generalized Lotka's law reveals the relationship between author ratio and the number of documents, and describes the frequency distribution law of scientific productivity. Its mathematical expression is:  $y(x) = C/x^n$  ( $1.2 < n < 3.8$ ) in which  $y(x)$  means number of authors who writing  $x$  pieces of articles [6]. The research team chooses the first author in each group to figure out whether author distribution in medical record management lectures fit generalized law of Lotca and the result is shown in TABLE III.

TABLE III. AUTHORS' PUBLICATION FREQUENCY

Article Number x	Author Number y(x)	Article Number x	Author Number y(x)	Article Number x	Author Number y(x)
1	3313	8	27	15	3
2	823	9	14	16	0
3	342	10	12	17	2
4	169	11	12	18	1
5	108	12	8	19	1
6	53	13	3	28	1
7	40	14	5		

According to data above, author group is considerable in this field, which is not fit for K-S examination [9]. Therefore, non-regression analysis is conducted to directly estimate parameters  $c$  and  $n$  in Lotka's Law.

On the basis of formula  $c = 1 / \sum_{x=1}^{\infty} \frac{1}{x^n}$ ,  $c$  can be worked out to match  $n$  in planning precision as TABLE IV shows [7].

TABLE IV. MATCHING BETWEEN C AND N

n	...	2.124	2.125	2.126	...	2.288	2.289	2.290	...
c	...	0.6484	0.6487	0.6490	...	0.6950	0.6952	0.6955	...

Base on TABLE III (processing  $1 \leq x \leq 15$ ), frequency of one article by authors is  $G = y(1) / \sum_{x=1}^{15} y(x) = 0.6717$ . At the significant level of 0.01, K-S examination allows max number  $D_{max} = 1.63 / \sqrt{\sum_{x=1}^{15} y(x)} = 0.0232$ . In the G-centered range with a radius of  $D_{max}$ ,  $c \in (G - D_{max}, G + D_{max})$  [7],  $c$  ranges from 0.6485 to 0.6949, matching with  $n$  from 2.124 to 2.288 according to TABLE IV.

Starting from  $n=2.13$ ,  $c=0.6502$ , the research team calculated deviation between theoretical and fact cumulative frequency with  $n$  increasing in a certain length.  $S_j$  stands for cumulative frequency of writing 1 to  $j$  pieces articles with parameters  $(n_j, c_j)$  [7].

TABLE V. MAXIMAL DEVIATION BETWEEN THEORETICAL AND FACT CUMULATIVE FREQUENCY

No.	n	c	$Max   S_j(n, c) - S_j  $
1	2.130	0.6502	0.04770537
2	2.140	0.6533	0.04586255
3	2.150	0.6563	0.04415725
4	2.160	0.6593	0.04244847
5	2.170	0.6622	0.04087559
6	2.180	0.6651	0.03929838
7	2.190	0.6680	0.03771682
8	2.200	0.6709	0.03613085
9	2.210	0.6737	0.03467841
10	2.220	0.6766	0.03308318
11	2.230	0.6793	0.03175796
12	2.240	0.6821	0.03028991
13	2.250	0.6848	0.02895318
14	2.260	0.6875	0.02761050
15	2.270	0.6902	0.02626186
16	2.280	0.6929	0.02490727
17	2.281	0.6931	0.02486340
18	2.282	0.6934	0.02468983
19	2.283	0.6937	0.02451328
20	2.284	0.6939	0.02447210
21	2.285	0.6942	0.02429543
22	2.286	0.6945	0.02411872
23	2.287	0.6947	0.02407729
24	2.2871	0.6948	0.02396489
25	2.2872	0.6948	0.02398781
26	2.2873	0.6948	0.02401072
27	2.2874	0.6948	0.02403363
28	2.2875	0.6949	0.023921238

When  $n=2.2875$ ,  $c=0.6949$ ,

$$(n, c) = \left\{ (n, c) \mid \min \left[ \max \left( | S_j(n_i, c_i) - S_j | \right) \right] \right\}$$

sets up<sup>[8]</sup>.  $C = y(x) * c = 3427.2468$

so that  $y(x) = 3427.2468 / x^{2.2875}$

In Lotka's Law, constant  $c$  is related to the field maturity. Large  $c$  means lower degree of maturity. With the increase of maturity,  $c$  will gradually reach the constant in standard Lotka's Law<sup>[8]</sup>. The  $c=0.6949$  got above is a little bit greater than the standard  $c=0.6079$ , which means medical record management is still not mature. Moreover, power exponent  $n$  presents

dispersion degree of authors' frequency. When  $n=2.2875$ , greater than standard  $n=2$ , it indicates a strong dispersion trend in this field.

### V. CONCLUSION

The growth pattern of scientific literatures reveals the process of slow development in the early stage, then acceleration, deceleration in the late stage and finally saturation. Above all, medical record management remains in its early stage, heading for next phase.

It is meaningful for the subject development to trace researchers' work when intensive knowledge discovery, theory research and industrial application are further advancing. To sum up, author group in medical record management is go from strength to strength and tend to cooperate in article publication. However, this filed remains in an immature stage according to Lotka's Law.

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