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Research article

A scientometric approach of dynamic science institutionalization in the field of laparoscopic proctocolectomy

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Abstract

This scientometric study analyzed the dynamic institutionalization of research on laparoscopic proctocolectomy and outlined the most significant institutions, scientists, journals and conference proceedings. A retrospective problem-oriented, title-word based search was done in Web of Science Core Collection (WoS), MEDLINE and BIOSIS Citation Index (BIOSIS) between 2008-2017. The following parameters were comparatively assessed: the annual dynamics of publications; the languages of publications; the authors; the journals; the scientific institutions; the scientific forums and citations received. There were 3,393 publications abstracted in WoS, 5,209 - in MEDLINE and only 488 - in BIOSIS. The papers were abstracted in WoS by researchers from 65 countries, whereas in BIOSIS – by researchers from 37 countries. There were 23 languages of publications in MEDLINE, 11 in WoS and 7 in BIOSIS. The journal Dis. Colon Rectum contained most of the papers abstracted on this topic. The Cleveland Clinic Foundation was the most influential scientific institution. The annual meetings of the American Society of Colon and Rectal Surgeons attracted the attention of most scientists all around the world. The paper by M.H. van der Pas et al. (Lancet Oncol. 2013; 14:210-218) received 393 citations in WoS. This comprehensive factual information could be properly used by coloproctologists in smaller countries and institutional science managers.

Keywords : laparoscopic proctocolectomy, science institutionalization, scientometrics, publication output, citation analysis, data-bases

Highlights

- ✓ The expansion of laparoscopic proctocolectomy is closely related to the effective science institutionalization in this narrow field and it is still not scientometrically analyzed.
- ✓ The resulting data could be properly used by coloproctologists in smaller countries and institutional science managers.

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Introduction

Pure exponential growth in the global pursuit of science builds on contrasting competitive trends - rising competitions between countries and international collaboration across national borders (1). Home to many of the oldest research universities and other organizational forms, such as academies and research institutes, Europe is the core of scientific productivity between North America and Eastern Asia (2). Universities and extra-university research institutes provide facilities and support for intercultural collaboration and learning and for scientific discovery, extending massive educational expansion in societies worldwide (3), since countries benefit from the strength of the research universities (4).

The socio-medical importance of neoplastic and inflammatory colorectal diseases continuously increases and requires the joint efforts of specialists in coloproctology and different oncological areas. Successful laparoscopic restorative proctocolectomies were already possible about two decades ago as an appealing alternative to conventional open proctocolectomy surgery. The application of laparoscopy to the ileoanal pouch surgery was first described by Peters (5) in 1992 (6). The feasibility and safety of laparoscopic ileoanal pouch surgery has been proved by investigators from specialized centers (7-9). More recently, there has been a growing number of publications devoted closely to laparoscopic proctocolectomy.

The comparison between laparoscopic abdominal transanal proctocolectomy with coloanal anastomosis, low anterior resection, and abdominoperineal resection in 418 patients with low-lying rectal cancer proves that the first procedure is technically feasible and an oncologically safe surgical option (10). In a patient with a history of ulcerative colitis suffering from synchronous rectal and prostate cancer, the combination of simultaneous laparoscopic proctocolectomy and Retzius sparing robot-assisted radical prostatectomy for synchronous rectal and prostate cancer is both feasible and safe (11) The laparoscopic and open approaches of proctectomy in 488 rectal cancer patients with a mean age of 59 years provide similar values in terms of the direct cost of hospitalization for primary resection (12). In a 42-year-old female patient with synchronous triple colorectal adenocarcinoma, subtotal laparoscopic proctocolectomy and ileorectal anastomosis with lymph node dissection along the surgical trunk as well as central vascular ligation of the ileocolic artery, inferior mesenteric artery and right and left branches of the middle colic artery result in uneventful postoperative evolution of the patient (13).

The aim of the present study is to analyze scientometrically the dynamic science institutionalization on the specific topic of "laparoscopic proctocolectomy" as reflected in the information portals Web of Science Core Collection (WoS), MEDLINE and BIOSIS Citation Index (BIOSIS) of Web of Science (Clarivate Analytics, USA) and to outline the significant institutions, scientists, journals, and conference proceedings in this rapidly advancing field.

Materials and Methods

In February 2018, a retrospective problem-oriented, title-word based search was done in *Web of Science Core Collection* (WoS), *MEDLINE* and *BIOSIS* of Web of Science (Clarivate Analytics, USA) for the time period between 2008-2017. The following scientometric parameters of the publication output and citation activity were comparatively assessed: i) the annual dynamics of publications – the number of abstracted publications – the total and the yearly number; ii) the languages of publications, iii) the authors – the number of unique names, the number of publications, and the country belongings; iv) the journals – the total and the yearly number, the number of abstracted articles from single journals; v) the scientific institutions – the organizational types, the country belongings and the thematic belongings; vi) the scientific forums – the number of publications and the thematic belongings; and vii) the citations (the number of citations to publications by single authors received in *WoS, MEDLINE* and *BIOSIS* during this ten-year period and computerized citation metrics).

Results

There were 3,393 publications abstracted in *WoS*, 5,209- in *MEDLINE* and only 488 - in *BIOSIS*. The annual dynamics of publications on the topic abstracted in three data-bases is illustrated in Figure 1.

The comparison between the first and the last three-year periods (2008-2010 towards 2015-2017) indicates an increasing rate of publications amounting to 85.85% in terms of *WoS*, 109.78% - of *BIOSIS* and 66.64% - of *MEDLINE.*

Papers by researchers from 65 countries were abstracted in *WoS,* and from 37 countries - in *BIOSIS*. The country distributions according to the number of publications on the topic abstracted in *WoS* and *BIOSIS* are demonstrated in Figure 2 and in Figure 3.

There are 23 languages of publication in *MEDLINE*, 11- in *WoS* and 7 - in *BIOSIS* (Table 1).

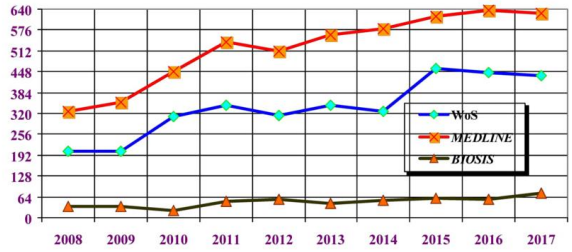

Figure 1. The annual dynamics of publications on the topic abstracted in three data-bases

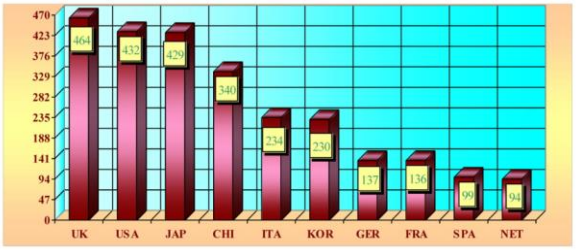

Figure 2. The country distributions according to the number of publications on the topic abstracted in *WoS*

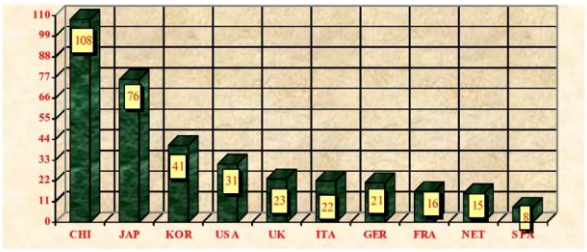

Figure 3. The country distributions according to the number of publications on the topic abstracted in *BIOSIS*

Table 1. Most common languages of publications on the topic in *WoS*, *MEDLINE* and *BIOSIS*

Language	*WoS*		*MEDLINE*		*BIOSIS*	
	n	%	n	%	n	%
English	3298	97.20	4671	89.67	469	96.11
German	45	1.33	51	0.010	3	0.006
Spanish	29	0.86	59	0.011	1	0.002
French	11	0.32	23	0.004	-	-
Chinese	-	-	210	0.04	7	0.014
Japanese	-	-	107	0.02	3	0.006
Russian	-	-	26	0.005	4	0.008
Hungarian	1	0.03	11	0.002	1	0.002
Czech	-	-	18	0.003	-	-

The fifteen most productive authors on the topic in *WoS*, *MEDLINE* and *BIOSIS* are listed in Table 2. The institutions of these 15 most productive authors (see Table 2) on the topic in *WoS* are listed below.

1. The Japanese Foundation for Cancer Research, Gastroenterology Center, The Cancer Institute Hospital, The Department of Gastroenterological Surgery, Ariake, Tokyo, Japan (5 publications)
2. Kitasato University School of Medicine, The Department of Surgery, Kanagawa 2520374, Japan
3. Komagome Hospital, Tokyo Metropolitan Cancer and Infectious Diseases Center, The Department of Surgery, Tokyo, Japan
4. Yonsei University College of Medicine, Severance Hospital, The Department of Surgery, Division of Colon and Rectal Surgery, Seoul 120752, South Korea (3 publications)
5. Kyung Hee University School of Medicine, The Department of Surgery, Seoul 130872, South Korea
6. The Catholic University of Korea, The College of Medicine, The Department of Surgery, Seoul 06591, South Korea
7. The University Hospital of Cleveland, Case Medical Center, The Division of Colorectal Surgery, Cleveland, OH 44106, USA
8. The University of California, Irvine, Irvine Medical Center, The Department of Surgery, The Division of Trauma, Burns and Surgical Critical Care, Orange, CA 92868-3298, USA
9. Poole Hospital, The Department of Colorectal Surgery, Dorset BH15 2JB, England, UK

Ten "core" journals containing most papers on the topic abstracted in *WoS* and *MEDLINE* are comparatively shown in Table 3. The analysis of the thematic belongings of the titles of top 25 journals in *WoS* and *MEDLINE* each identifies the dominance of the surgical discipline presenting with 12 journals. Next, there are the endoscopy journals (with five titles) followed by oncology, coloproctology and gastroenterology (with four titles each). In *BIOSIS*, the five "core" journals are the following: *Int J Colorectal Dis* (with 109 abstracted articles), *Gastroenterology* (with 44 abstracted articles, but absent in *MEDLINE*), *Hepatogastroenterology* (with 39 abstracted articles), *Medicine* (Hagerstown) (with 28 abstracted articles), and *Surgery* (St. Louis) (with 19 abstracted articles).

The ten most productive institutions on the topic in *WoS* are outlined in Table 4, while the four scientific forums with the most numerous abstracted publications - in Table 5.

In *WoS*, a total of 175 single events of 93 scientific forums such as meetings, congresses, conferences and symposia with a total of 710 unique publications on this topic are abstracted. The corresponding figures for *BIOSIS* are the following: 30, 19, and 79.

The cumulative computerized citation patterns on the topic in *WoS* and *BIOSIS* are summarized in Table 6.

Table 2. Most productive authors on the topic in *WoS*, *MEDLINE* and *BIOSIS*

Rank	Author's name	Country	*WoS*	*MEDLINE*	*BIOSIS*
1.	Masahiko Watanabe	Japan	48	35	6
2.	Conor P. Delaney	USA	45	48	3
3.	Toshiharu Yamaguchi	Japan	49	24	5
4.	Takashi Akiyoshi	Japan	39	39	4
5.	Masashi Ueno	Japan	38	38	4
6.	Kang Young Lee	South Korea	33	32	8
7.	Yosuke Fukunaga	Japan	32	34	3
8.	Yoshia Fujimoto	Japan	32	33	4
9.	Tsuyoshi Konishi	Japan	30	35	3
10.	Amjad Parvaiz	UK	33	17	2
11.	Hyuk Hur	South Korea	30	32	5
12.	Nam Kyu Kim	South Korea	29	36	9
13.	Seung Hyuk Baik	South Korea	27	34	7
14.	Alessio Pigazzi	USA	26	23	2
15.	Jun-Gi Kim	South Korea	26	18	2

Table 3. 'Core' journals on the topic in *WoS* and *MEDLINE*

Rank	Journal title	*WoS*	*MEDLINE*
1.	*Diseases of the Colon & Rectum*	389	183
2.	*Surgical Endoscopy and Other Interventional Techniques*	361	574
3.	*Colorectal Disease*	186	291
4.	*British Journal of Surgery*	197	90
5.	*Surgical Laparoscopy, Endoscopy & Percutaneous Techniques*	128	197
6.	*International Journal of Colorectal Disease*	122	167
7.	*Techniques in Coloproctology*	107	159
8.	*Journal of Laparoendoscopic & Advanced Surgical Techniques*	94	161
9.	*Annals of Surgery*	81	108
10.	*World Journal of Surgery*	59	89

Table 4. Most productive institutions on the topic in *WoS*

Rank	Institution	Country	n
1.	Cleveland Clinic Foundation	USA	87
2.	Japanese Foundation for Cancer Research	Japan	83
3.	Imperial College London	UK	71
4.	Case Western Reserve University	USA	63
5.	Assistance Publique Hopitaux Paris	France	61
6.	University of London	UK	48
7.	Yonsei University	South Korea	43
8.	Vrije Universiteit Amsterdam	The Netherlands	43
9.	Osaka University	Japan	41
10.	University of Barcelona	Spain	39

Table 5. Scientific forums with most publications abstracted on the topic in *WoS*

Rank	Scientific forum title	Single events	Publications
1.	Annual Meeting of the American Society of Colon and Rectal Surgeons (ASCRS)	5	273
2.	Digestive Disease Week Conference (DDW)	12	49
3.	Annual Meeting of the Society of American Gastrointestinal and Endoscopic Surgeons (SAGES)	8	33
4.	Annual Clinical Congress of the American College of Surgeons	8	19

Table 6. Cumulative citation patterns on the topic in *WoS* and *BIOSIS*

Citation parameter	*WoS*	*BIOSIS*
total number of publications	3393	488
sum of the times cited	32008	803
sum of the times cited without self-citations	20.424	539
percentage of these times cited	63.81	67.12
citing articles	11102	604
citing articles without self-citations	9080	466
percentage of these citing articles	81.79	77.15
average citations per item	9.43	1.65
average citations per year	2909.82	73.00
articles cited at least once	2058	225
percentage of these articles	60.65	46.11
h-index	72	12

The analysis of the count of the citations received by top 30 articles reveals that the corresponding numbers range from 109 to 393 in *WoS*, from 131 to 393 - in *MEDLINE*, and from 7 to 32 - in *BIOSIS*. Nine papers appear in *MEDLINE* only, but 25 - in *BIOSIS* only. The 10 most cited articles on the topic in *WoS* are indicated in Table 7. It should be added that the paper by P. Bucher *et al.* from Switzerland (*Int J Colorectal Dis.* 2008; 23: 1013-1016) has received a total of 309 citations in *MEDLINE*.

Table 7. Ten most cited articles on the topic in *WoS*

First author's name	Country	Journal title, volume, year & pages	n
M.H.G.M. van der Pas *et al.*	The Netherlands	*Lancet Oncology* 2013,19,210-218	393
F.H. Remzi *et al.*	USA	*Colorectal Diseases* 2008,10,823-826	366
S.B. Kang *et al.*	South Korea	*Lancet Oncology* 2010,11,637-645	362
H.J. Bonjer *et al.*	The Netherlands	*Lancet Oncology* 2009,10,44-52	356
M.S. Vlug *et al.*	The Netherlands	*Annals of Surgery* 2011,254,868-875	312
A.M. Lacy *et al.*	Spain	*Annals of Surgery* 2008,248,1-7	309
J. Lujan *et al.*	Spain	*British Journal of Surgery* 2009,96,982-989	231
H.J. Bonjer *et al.*	The Netherlands	*New England Journal of Medicine* 2015,372,1324-1332	228
S.H. Baik *et al.*	South Korea	*Annals of Surgical Oncology* 2009,16,1480-1487	220
E. Kuhry *et al.*	Norway	*Cancer Treatment Reviews* 2008,34,498-504	213

Discussions

As a whole, our results display a considerable dynamic science stratification in this specific narrow field similarly to the majority of "hot" topics in contemporary clinical medicine and biomedicine.

There has been a gradual growth in the publication output during the whole period of observation. We established an outlined domination of the authors from the UK, USA and Japan in *WoS*, and from China, Japan and South Korea in *BIOSIS*. The relatively great absolute count and relative share of publications in Chinese and Japanese abstracted in *MEDLINE* are plentiful, indeed. Seven out of a total of the 15 most productive authors work in three scientific institutions in Japan, while five authors work in three scientific institutions in South Korea. The most productive institutions are located in seven countries from Europe, North America, and Asia. It is noteworthy that the percentages of the cited and citing articles without self-citations in *WoS* and *BIOSIS* are considerable. In *WoS*, the 10 most-cited papers are by authors from five countries. Out of them, there are four articles by researchers from the Netherlands and two by scholars from South Korea and Spain (one from each country).

There are certain advantages and disadvantages of these data-bases (14). Certain obvious differences in terms of quantitative parameters between the data-bases are due to the different editorial policy of these information centers. This should be improved in order to warrant an optimal coverage aim of the primary literature and more precise indexing algorithms.

According to an original scientometric concept, there is a unity of institutionalization, interdisciplinarity and internationalization of contemporary science and university education (15, 16). The integration of these components plays a crucial role in the further enhancement of research effectiveness and improvement of science infrastructure at an individual, local, national and international level (17).

The institutionalization of research includes the intrinsic features of the historically established disciplinary organization of scientific and higher educational structures according to the enhanced current requirements and already gained social recognition of the topic. Thus, it is an essential component of the mature scientific discipline or subdiscipline (16, 17, 18).

Along with the acknowledged problem-oriented denominations of single institutions of different

organizational type, the following essential components belong to science institutionalization (17, 18): i) the organization of national and international scientific forums on a concrete interdisciplinary (or narrow-monodisciplinary) topic; ii) the regular publication of problem-oriented and narrow- or broad-profile inter- or monodisciplinary journals and monographs and their subsequent inclusion in secondary information sources and data-bases; iii) the foundation of national and international scientific societies and associations; iv) the establishment of corresponding university departments and/or their subdivisions granting the regular education of students; v) the introduction of postgraduate studies and preparation of doctoral dissertations; vi) the introduction of the topic into the university students' curricula, initially, in the form of extracurricular activity such as invited lectures delivered by experts from the same country or abroad, the publication of textbooks and manuals, the organization of summer schools, etc.; vii) the creation and subsequent dynamic development of corresponding paradigms or paradigm circles, etc.

Some newly-published investigations testify the constant interest in science institutionalization worldwide.

The neo-institutional analysis of a comprehensive historical database from 1900 to 2010 reveals both stable and dynamic patterns of production and productivity in the fields of Science, Technology, Engineering, Mathematics, and Health in Germany, France, Belgium, and Luxembourg and reveals the varying contributions of different organizational forms, especially research universities and research institutes (2). The comparison between the institutionalization pathways that create the conditions necessary for the continuous and strong growth in scientific productivity reveals the research university as the key organizational form across countries.

The professionalization and institutionalization of the history of psychology as a specialty in the United States of America is analyzed as a historical-sociological model (19). Although in the late XIXth and the early XXth centuries, German scholarship represents a model that deeply inspires sociologists across the United States, the institutionalization of sociology within the American universities takes place much earlier and faster than in their German counterparts (20).

The institutionalization framework elements such as nominal, leadership, administrative support, multi-yearly funding, research targets, formal researcher-to-researcher exchange, visibility, evaluation, and supporting characteristics are examined in five case studies of the institutionalization framework in order to account for the development of international university research ventures between the US universities, on the one hand, and China and Singapore's universities, on the other hand (21). Both the institutionalization and the internationalization of research devoted to the applications of the geographical information systems in health planning are scientometrically ascertained (14).

The emerging institutionalization of collaborative university-industry networks in Russia is explored by means of conceptual perspectives from institutional theory, especially based on arguments from the strategic choice, network-building, and network failure studies (22). The process of institutionalization of Russian traumatology and orthopedics is examined (23). The contributions made by Howard Wilcox Haggard to the institutionalization and consolidation of modern alcohol studies in the twentieth-century post-Prohibition America are considerable (24). The crucial role played by Ernst von Leyden (1832-1910) in the institutionalization of cancer research in Germany since 1900 is being emphasized (25). The institutionalization of a palliative and end-of-life care educational program is implemented in a medical school curriculum at the University of Maryland School of Medicine in Baltimore, MD, USA (26). Due to the inevitable cooperation of different hospital specialties, the institutionalization of skull base surgery is possible through the creation of the Interdisciplinary Center of Skull Base Surgery at the University Hospital of Leipzig, Germany, in 1997 (27). The history of the institutionalization of asylum and forensic psychiatry in Bucharest during the XIXth century is also described (28). The institutionalization of neuroethics in Korea is an integral component of Korea's Brain Initiative within the neuroscience research (29).

Conclusions

The expansion of laparoscopic proctocolectomy in modern coloproctology is closely related to the effective science institutionalization in this narrow field and it is still not scientometrically analyzed. A durable increase in the world's publication output and international prestige of the scientific community from powerful and smaller countries has convincingly been proved as a result of the effective science institutionalization in the most productive centers worldwide. Our present results convincingly demonstrate that the constellation of such specific scientometric indicators enlarges the capacities of problem-oriented analyses and faces the challenges of the timely identification of the essential patterns of scientific advances in these rapidly expanding interdisciplinary

fields. They are in line with the tendency towards the broader implementation of the scientometric approach to the timely identification of promising research topics. The systematized files with bibliographic, abstracted and full-text information about laparoscopic proctocolectomy could successfully be used by experienced coloproctologists and beginners from smaller countries, institutional and national science managers and journal editors, as well as in the practice-oriented research involving national and/or international collaborative teams. This complex scientometric methodology could become popular in the postgraduate university curricula.

Conflict of interest disclosure

There are no known conflicts of interest in the publication of this article.

Compliance with ethical standards

Any aspect of the work covered in this manuscript has been conducted with the ethical approval of all relevant bodies and that such approvals are acknowledged within the manuscript.

References

1. Zhang L, Powell JJW, Baker DP. Exponential growth and the shifting global center of gravity of science production, 1900-2011. *Change: Magazine Higher Learn*. 2015; 47(4): 46-9. DOI: 10.1080/00091383.2015.1053777
2. Powell JJW, Dusdal J. Science production in Germany, France, Belgium, and Luxembourg: Comparing the contributions of research universities and institutes to science, technology, engineering, mathematics, and health. *Minerva*. 2017; 55(4): 413-34. DOI: 10.1007/s11024-017-9327-z
3. Schofer E, Meyer JW. The worldwide expansion of higher education in the twentieth century. *Am Sociol Rev*. 2005; 70(6): 898-920. DOI: 10.1177/000312240507000602
4. Baker DP. The schooled society: the educational transformation of culture. Stanford University Press, Stanford. 2014.
5. Peters WR. Laparoscopic total proctocolectomy with creation of ileostomy for ulcerative colitis: report of two cases. *J Laparoendosc Surg*. 1992; 2(3): 175-8. DOI: 10.1089/lps.1992.2.175
6. Hemandas AK, Jenkins JT. Laparoscopic pouch surgery in ulcerative colitis. *Ann Gastroenterol*. 2012; 25(4): 309-16. PMID: 24714253
7. Thibault C, Poulin EC. Total laparoscopic proctocolectomy and laparoscopy-assisted proctocolectomy for inflammatory bowel disease: operative technique and preliminary report. *Surg Laparosc Endosc*. 1995; 5(6): 472-6. PMID: 8611996
8. Santoro E, Carlini M, Carboni F, Feroce, A. Laparoscopic total proctocolectomy with ileal J pouch-anal anastomosis. *Hepatogastroenterology*. 1999; 46(26): 894-9. PMID: 10370634
9. Marcello PW, Milsom JW, Wong SK, Hammerhofer KA, Goormastic M, Church JM, et al. Laparoscopic restorative proctocolectomy: case-matched comparative study with open restorative proctocolectomy. *Dis Colon Rectum*. 2000; 43(5): 604-8. DOI: 10.1007/BF02235570.pdf
10. Kye BH, Kim JG, Cho HM, Kim HJ, Chun CS. Laparoscopic abdominal transanal proctocolectomy with coloanal anastomosis is a good surgical option in selective patients with low-lying rectal cancer: A retrospective analysis based on a single surgeon's experience. *J Laparoendosc Adv Surg Tech A*. 2018; 28(3): 269-77. DOI: 10.1089/lap.2017.0226
11. Gys B, Fransis K, Hubens G, Van den Broeck S, Op de Beeck B, Komen N. Simultaneous laparoscopic proctocolectomy (TaTME) and robot-assisted radical prostatectomy for synchronous rectal and prostate cancer. *Acta Chir Belg*. 2019; 119(1): 47-51. PMID: 29198168. DOI: 10.1080/00015458.2017.1411550
12. Silva-Velazco J, Dietz DW, Stocchi L, Costedio M, Gorgun E, Kalady MF, et al. Considering value in rectal cancer surgery: an analysis of costs and outcomes based on the open, laparoscopic, and robotic approach for proctectomy. *Ann Surg*. 2017; 265(5): 960-8. DOI: 10.1097/SLA.0000000000001815
13. Okoshi K, Mizumoto M, Kinoshita K. Laparoscopic subtotal proctocolectomy for synchronous triple colorectal cancers: a case report. *Asian J Endosc Surg*. 2016; 9(4): 303-6. DOI: 10.1111/ases.12304
14. Murad AA, Tomov DT. Institutionalization and internationalization of research on the applications of the geographical information systems in health planning. *Scientometrics*. 2012; 91(1): 143-58. DOI: 10.1007/s11192-011-0567-7
15. Tomov DT. Internationalization of interdisciplinary scientific communications (the case of testicular morphology). PhD thesis. Centre for Science Studies, Sofia (in Bulgarian). 1998.
16. Tomov DT. The unity of interdisciplinarity, institutionalization and internationalization of science:

reflections from/on cell biology. *Biomed Rev (Varna)*. 2001; 12: 41-55.

17. Tomov DT. Institutionalization of interdisciplinary research under the conditions of internationalization (scientometric and historiographic aspects of the problem of 'memory'). DSc thesis. Centre for Science Studies and History of Science, Sofia (in Bulgarian). 2010.
18. Tomov D, Ivanov K, Kolev N, Donev I. Dynamic institutionalization of research in the field of colorectal tumour markers. *J Gastroenterol Compl*. 2018; 1: 205.
19. Fierro C. The professionalization and institutionalization of history of psychology as a specialty in the United States of America: influences from the history, the sociology and the philosophy of science. *Rev Argent Cienc Comport*. 2016; 8(2): 67.
20. Sala R. The rise of sociology. Paths of institutionalization in Germany and the United States around 1900. *Geschichte Ges*. 2017; 43(4): 557-84. DOI: 10.13109/gege.2017.43.4.557
21. Youtie J, Li Y, Rogers J, Shapira P. Institutionalization of international university research ventures. *Res Policy*. 2017; 46(9): 1692-705. DOI: 10.1016/j.respol.2017.08.006
22. Bychkova O. Innovation by coercion: Emerging institutionalization of university-industry collaborations in Russia. *Soc Stud Sci*. 2016; 46(4): 511-35. DOI: 10.1177/0306312716654768
23. Grishin SE, Demidova EI, Puchinyan DM, Fedonnikov AS, Norkin LA. The institutionalization of traumatology and orthopedics in Russia. *Probl Sots Gig Zdravookhran Istor Med*. 2017; 25(6): 371-3 (in Russian). DOI: 10.1016/0869-866X-2017-25-6-371-373
24. Allred N, Bejarano W, Ward J. Howard Wilcox Haggard and the institutionalization of modern alcohol studies. *J Stud Alcohol Drugs*. 2017; 78(2): 325-9. DOI: 10.15288/jsad.2017.78.325
25. Kohl T. Ernst von Leyden und die Institutionalisierung der Krebsforschung zwischen 1896 und 1911. *NTM Z Geschichte Wissensch Technik Med*. 2016; 24(1): 39-60. DOI: 10_1007-S00048-016-0134-7
26. Ross DD, Fraser HC, Kutner JS. Institutionalization of a palliative and end-of-life care educational program in a medical school curriculum. *J Palliat Med*. 2001; 4(4): 512-8. DOI: 10.1089/109662101753381683
27. Frerich B, Seifert V, Bootz F, Hemprich A, Spanehl O. Institutionalisierung der Schädelbasischirurgie. Aufbau, Konzept und erste Erfahrungen des Interdiziplinären Zentrums für Schädelbasischirurgie der Universität Leipzig (IZSL). *Mund Kiefer Gesichtschir*. 2000; 4(4): 245-8. DOI: 10.1007/s100060000164
28. Buda O, Hostiuc S, Drima E, Ghebaur L, Popescu I, Staicu L, et al. The institutionalization of asylum and forensic psychiatry in Bucharest, 19th century. A historical outline. *Rom J Legal Med*. 2013; 21(1): 79-84. DOI: 10.4323/rjlm.2013.79
29. Jeong SJ, Lee IY, Jun BO, Ryu YJ, Sohn JW, Kim SP, et al. Korea Brain Initiative: Emerging issues and institutionalization of neuroethics. *Neuron*. 2019; 101(3): 390-3. DOI: 10.1016/j.neuron.2019.01.042