



# Broadening Our Horizons: Increasing Diversity of Scientific Publications From Taiwan Emergency Physicians, 2012–2017

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**Background:** Scientific publications and academic research are objective indicators that provide dynamic views of the evolution of emergency medicine (EM). This study is aimed to evaluate the academic contribution of Taiwan emergency departments (EDs) by analyzing scientific publications.

**Methods:** This is an observational study and all publications between 2012 and 2017 were retrieved from the Scopus database. The EM journals were adopted from the 2016 *Journal Citation Reports (JCR)* category of EM. Three groups of publications were enrolled: (1) publications with first authors affiliated with Taiwan EDs in EM journals; (2) publications with first authors affiliated with Taiwan EDs in non-EM journals; (3) publications with first authors affiliated with Taiwan other than EDs in EM journals. Data regarding the name and category of the publishing journal, the publication year, the publication type, and the number of citations were collected for further analysis. The publication and category numbers were also merged with previous study to obtain a longer trend analysis from 1992.

**Results:** A total of 291 publications affiliated with Taiwan EDs were published in EM journals and 697 publications in 275 non-EM journals. A total of 286 publications in EM journals affiliated with Taiwan but other than ED. The trend of publication numbers in all three groups and category numbers since 1992 were increasing (all  $p < 0.001$ ). Publication numbers in non-EM journals increased the most and obtained the highest cited times. The 275 non-EM journals were classified into 69 categories. The leading five categories were Medicine, General & Internal, Multidisciplinary Sciences, Surgery, Infectious Diseases, Geriatrics & Gerontology.

**Conclusions:** The importance of researches originating from Taiwan EDs has been increasingly recognized by both the global EM community and by other medical specialties during the past 25 years. The advancement of academic contribution by Taiwan EDs is evident from the perspectives of quantity and breadth.

**Key words:** *scientific publications, Scopus database, emergency medicine, Journal Citation Reports*

## Introduction

Emergency medicine (EM) is a relatively new specialty which started to develop in Taiwan in the 1990s.<sup>1</sup> Milestones such as the founding of national organizations, nationally recognized medical specialty, board certification, standardized residency training,

and specialty journals have been used to evaluate the progress of EM.<sup>2</sup> Taiwan Society of Emergency Medicine (TSEM), the largest national emergency physicians organization in Taiwan, was founded in 1994. EM became the 23rd primary medical specialty in Taiwan in 1997.<sup>3</sup> The development and monitoring of residential training programs, board certification exam

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are organized by TSEM under the official authorization of Ministry of Health and Welfare. *Journal of Acute Medicine* is the official peer-reviewed EM journal published by TSEM. However, these indicators do not provide a qualitative, quantitative, and continuous measurement of the progress of EM. Scientific publications and academic research are objective indicators that provide dynamic views of the evolution of EM.<sup>4</sup> Despite heavy work loading and tremendous pressure, emergency physicians in Taiwan have a wide variety of interests and have made substantial academic contributions before 2011.<sup>5</sup> This study aims to evaluate the academic contribution from Taiwan emergency departments (EDs) between 2012 and 2017 from the perspective of scientific publications.

## Methods

### Study Design and Setting

This is an observational study and no human subject was involved. All publications were retrieved from the Scopus database. The study period was between 2012 and 2017. The EM journals were adopted from the 2016 *Journal Citation Reports* (JCR) category of EM (Supplement Table 1).

### Selection of Publications

All publications with first authors affiliated with Taiwan EDs and publications in EM journals originating from Taiwan were included. The origination of publication was classified according to the affiliation of first author. The enrolled publications were classified into three groups for comparison: Group 1: publications with authors affiliated with Taiwan EDs in EM journals; Group 2: publications with first authors affiliated with Taiwan EDs in non-EM journals; Group 3: publications with first authors affiliated with Taiwan other than EDs in EM journals.

### Study Protocol

A computerized literature search was conducted using the Scopus database on January 1, 2018. Publications with first authors affiliated with Taiwan EDs were retrieved by the search term “AFFILCOUNTRY (Taiwan) AND AFFIL (emergency) AND PUBYEAR AFT 2011 AND PUBYEAR BEF 2018.” We reviewed the retrieved results to exclude publications with first authors who were not affiliated with Taiwan

EDs and then classified these articles according to journal category: EM journals (Group 1) and non-EM journals (Group 2). Publications in EM journals by first authors affiliated with Taiwan but not from EDs (Group 3) were retrieved by the search term “ISSN (xxxx-xxxx) AND PUBYEAR AFT 2011 AND PUBYEAR BEF 2018 AND AFFILCOUNTRY (Taiwan)” and then reviewed to enroll publications with first authors affiliated with Taiwan other than ED. The ISSN (xxxx-xxxx) referred to the International Standard Serial Number of EM journals. We collected data regarding publications including title and category of journal, publication year, number of citations, and publication type for further analysis. In order to provide a longer perspective on the trend of publication and category numbers, we also merge these numbers with previous study on trend between 1992 and 2011 according to 2010 *JCR* journal list to obtain a longer trend analysis.<sup>5</sup> The journal list difference between 2016 and 2010 *JCR* EM category was the *World Journal of Emergency Surgery* (*WJES*), which was published since 2006 and listed in the *JCR* since 2012. There was no publication with first author affiliated with Taiwan in *WJES* before 2013. It is not necessary to recalculate the publication numbers between 1992 and 2011 when we combined these two data sets.

### Outcome Measurements

The primary outcome measurements were the trends of publication numbers of three study groups and category numbers of non-EM journals that published researches from Taiwan EDs. The secondary outcome measures were (1) the citations and types of publications difference between three study groups, (2) the distribution of non-EM journals publishing researches from Taiwan EDs, and (3) the distribution of non-EM categories publishing researches from Taiwan EDs.

### Analysis

Trends of the publication numbers and category numbers were evaluated by linear regression. The slope ( $\beta$ ) of the linear regression was used to represent the trend. The 95% confidence intervals (CIs) of  $\beta$  were calculated. Wilcoxon rank-sum test was used to analyze the number of citations difference between groups. Chi-squared test was used to analyze the publication type difference between groups. Descriptive statistics were used to analyze the distribution and

number of citations. SAS statistical software version 9.2 (SAS Institute Inc., Cary, NC, USA) was used to perform all the analysis listed above.

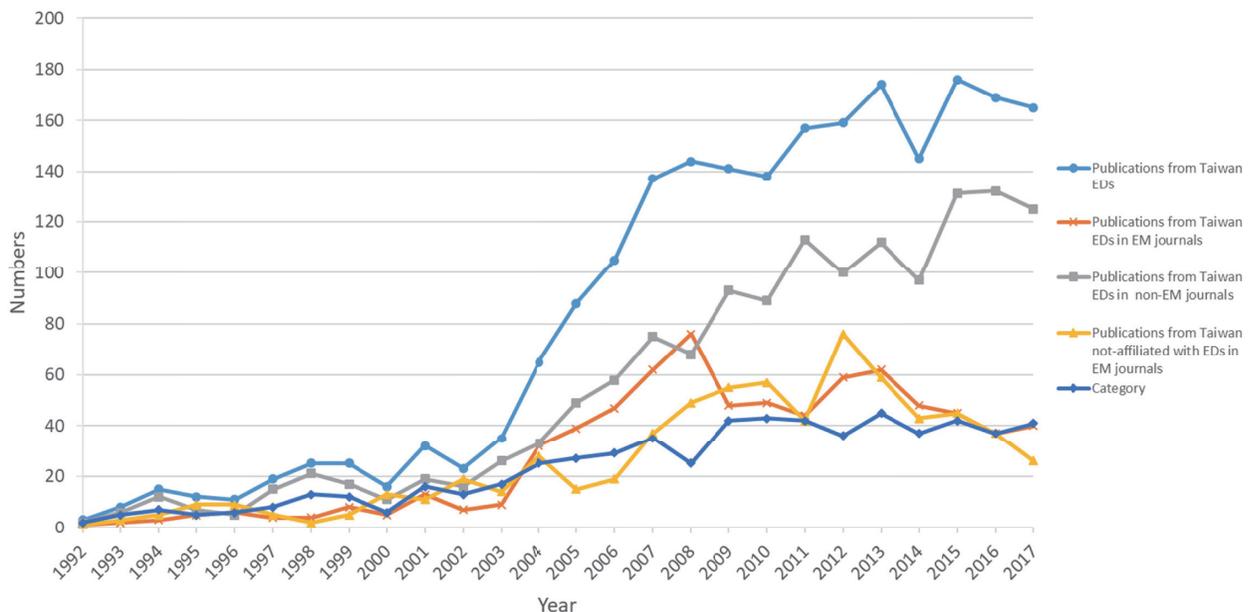
## Results

A total of 2,585 publications were retrieved in the initial search to identify researches affiliated with Taiwan EDs. In the review process, 1,411 publications were excluded because ED physicians were not the first authors, 148 publications were excluded because they were published in non-JCR journals. Of the remaining 988 publications with first authors affiliated with Taiwan EDs, 291 were published in EM journals and 697 were published in non-EM journals. A total of 286 publications in EM journals were affiliated with first authors from Taiwan and departments other than ED. The number of publications with first authors affiliated with Taiwan EDs in EM and non-EM journals, affiliated with Taiwan other than ED in EM journals, and the category number of non-EM journals that published researches from Taiwan EDs were in Fig. 1. The numbers before 2011 were adopted from previous study to disclose a longer evolution trend.<sup>5</sup>

The trends of publication and category numbers (1992–2017), distribution of citations, and publication

type (2012–2017) by study groups are listed in the Table 1. There was no statistic differences between the median of cited times of publications with first authors affiliated with Taiwan EDs in EM journals and non-EM journals ( $p = 0.05$ ), median of cited times of publications with first authors affiliated with Taiwan EDs and affiliated with other departments ( $p = 0.65$ ). There was no statistic difference between the publication types of article and non-article when comparing publications from Taiwan EDs in EM journals and non-EM journals ( $p = 0.51$ ), publications in EM journals from Taiwan EDs and non-ED ( $p = 0.67$ ).

A total of 275 non-EM journals published 697 publications with first authors affiliated with Taiwan EDs. Non-EM journals that published more than five publications originated from Taiwan ED are shown in Fig. 2. *PLoS ONE* published 7.7% (54/697) and *Medicine* published 6.6% (46/697) of the publications in non-EM journals. The 275 non-EM journals were classified into 69 categories. Categories that included more than five publications are shown in Fig. 3. The leading five categories were Medicine, General & Internal, Multidisciplinary Sciences, Surgery, Infectious Diseases, Geriatrics & Gerontology, with 167, 63, 57, 54, and 51 publications, respectively. The five leading categories (5/69, 7.2%) published 56.2% (392/697) of the publications.

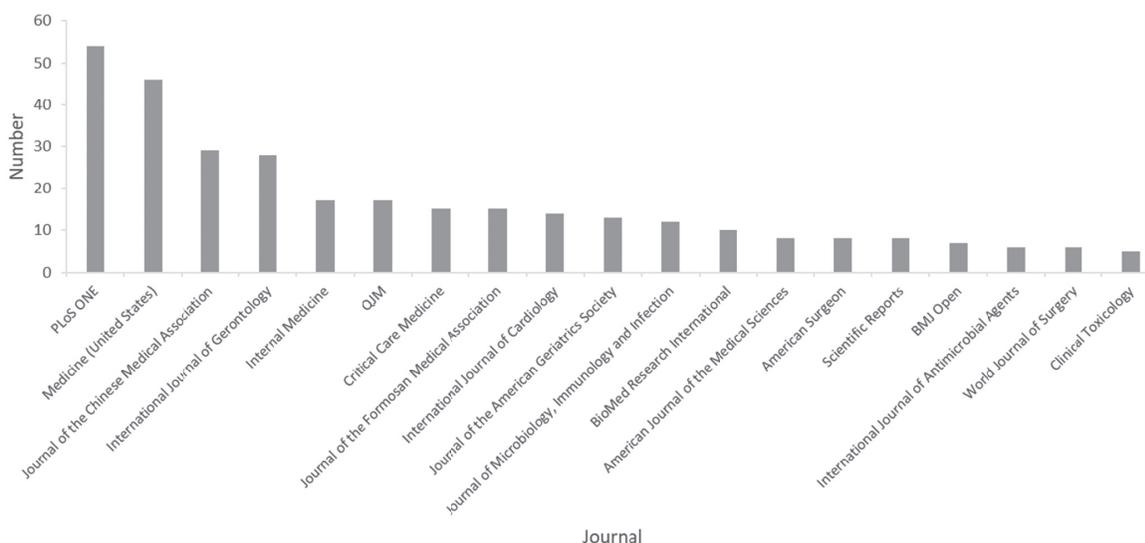


**Fig. 1.** The publication number of first authors affiliated with Taiwan emergency departments (EDs) in emergency medicine (EM) and non-EM journals, affiliated with Taiwan other than EDs in EM journals, and the category number of non-EM journals that published researches from Taiwan EDs. The numbers before 2011 were adopted from previous study to disclose a longer evolution trend.<sup>5</sup>

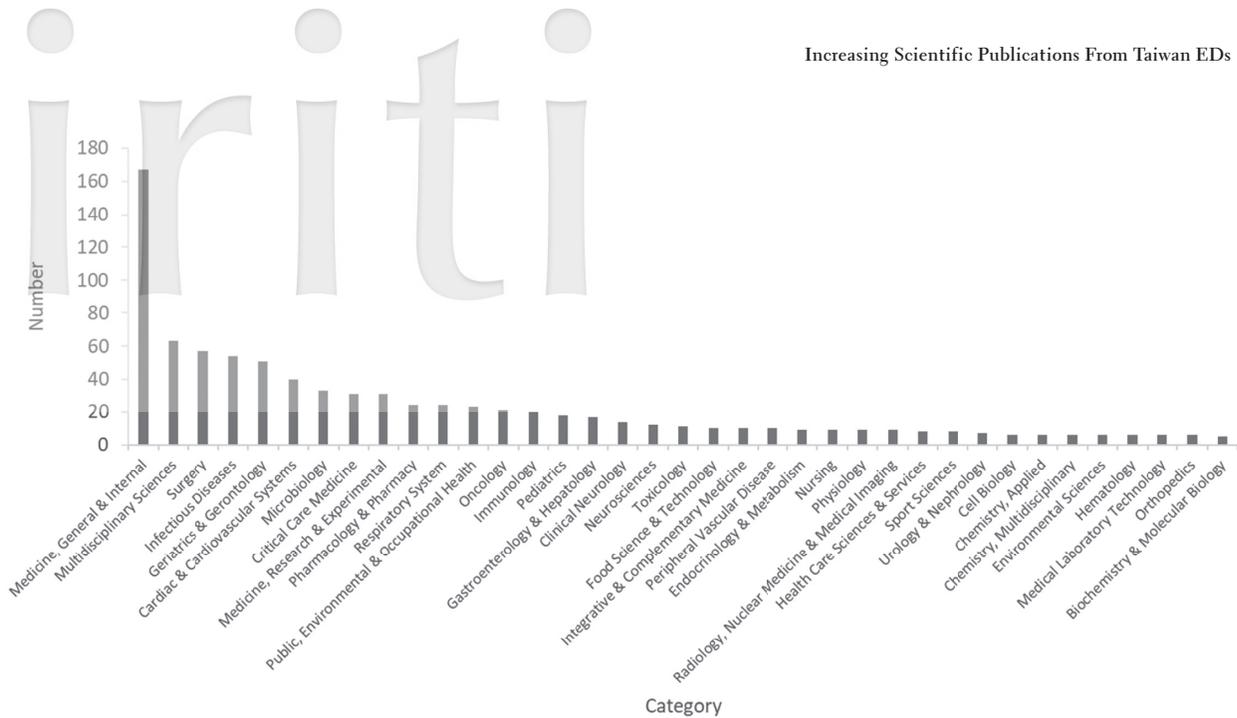
**Table 1.** The trends of publication and category numbers, distribution of citations, and publication type by study groups

	Publications from Taiwan EDs in EM journals	Publications from Taiwan EDs in non-EM journals	Publications from Taiwan not-affiliated with EDs in EM journals	Category numbers of non-EM journals
Trend (1992–2017)	2.55	5.73	2.27	1.84
95% CI	1.79–3.30	5.00–6.46	1.58–2.96	1.64–2.18
<i>p</i> -value	< 0.001	< 0.001	< 0.001	< 0.001
Cited times (2012–2017)				
Maximum	58.00	81.00	64.00	-
Mode	0.00	0.00	0.00	-
Medium	1.00	1.00	1.00	-
Mean	3.56	4.18	3.87	-
Standard deviation	7.00	8.15	7.54	-
Publication type (2012–2017)				
Article	225	552	223	-
Short survey	13	1	14	-
Note	21	37	27	-
Letter	27	63	14	-
Review	2	29	4	-
Erratum	0	7	3	-
Editorial	1	8	0	-
Conference paper	2	0	1	-

CI: confidence interval; EDs: emergency departments; EM: emergency medicine.



**Fig. 2.** Non-emergency medicine journals that published more than five publications originated from Taiwan emergency departments (2012–2017).



**Fig. 3.** Categories that included more than five publications originated from Taiwan emergency departments (2012–2017).

## Discussion

EM is a rapid growing specialty in the house of medicine all over the world. The evolution of EM in every country can be measured by several common milestones: the establishment of specialty association, the publication of official journals, been recognized as board certified specialty, training program numbers, number of specialists, and publication numbers in international academic journals.<sup>6</sup> Out of these milestones, publication numbers can provide a dynamic and cross nation evaluation. In this study, we evaluated the evolution of academic performance of Taiwan EDs from the perspective of scientific publications in recent 6 years.

The publications from Taiwan EDs have increased over the past 20 years which indicated that the academic contribution has grown substantially. The bidirectional change of distribution of publications in EM and non-EM journals was found in Lee and Chaou study in 2016.<sup>5</sup> Our study disclosed that the trend is not a transient phenomenon but has continued till the end of our study period 2017. Publications from Taiwan EDs in EM journals reached peak in 2008 and continuous decreasing in the following 10 years. Publications from Taiwan EDs in non-EM journals were continuous increasing since 2008 for 10 years. This phenomenon can be rationalized by that study topics chosen by Taiwan EM physicians and

research quality are increasingly been accepted by journals in other specialties and categories. The year 2008 can be viewed as a milestone and break through point of the academic development of EM specialty in Taiwan. The bidirectional trend of publications in EM and non-EM journals is an unique phenomenon to Taiwan or a common evolution process during the academic development of EM specialty in other countries is not well understood and studied before. Further study on EDs publications trend in other countries can provide insights of the development process of EM specialty across different countries.

In addition to increasing publication number trend, the cited times may provide another perspective on publications impact. The maximum cited times were higher in publications from Taiwan ED in non-EM journals than in EM journals. The phenomenon can be rationalized by EM is a relative new and independent category in *JCR* since 2000.<sup>7</sup> There are 24 journals in category EM in 2016 *JCR*. The number and publication history of non-EM journals are much more and longer than EM journals that may obtain broader and diverse readership than EM journals; therefore, publications from non-EM journals are cited more than those from EM journals. This situation formulated a feedback cycle that increase the motivation of EM physicians more willing to submit their studies to non-EM journals in order to be noticed and cited more frequently. The difference between the

median of cited times of publications between 2012 and 2017 in non-EM and EM journals was marginal ( $p = 0.05$ ). The difference was evident when study period extend to 20 years.<sup>5</sup> The marginal difference in our result can be explained by the publication time in proximity to present day so that the cited times are not enough to reveal the difference. The category of non-EM journals publishing Taiwan EDs researches increase from 2 in 1992 to 43 in 2017. A total of 69 categories between 2012 and 2017 had publications from Taiwan EDs. This indicates that researches from Taiwan EDs have been increasingly accepted by a variety of specialties.

EM involved with multi-disciplines that EM related researches may also be published in non-EM journals, researches regarding other medical specialties may also be published in EM journals. Publications by first authors from Taiwan other than EDs in EM journals may reflect the contribution to EM by other medical specialties in Taiwan. There was no statistical difference between the median of cited times of publications between 2012 and 2017 in EM journals from EDs and non-EDs ( $p = 0.65$ ). It indicated that publications in EM journals from Taiwan EDs and non-EDs obtained similar citation patterns. The number of the publications in EM journals from Taiwan non-EDs was decreasing after 2012. This phenomenon may need further study to obtain rationale.

The leading five non-EM journals that publish researches from Taiwan EDs between 2012 and 2017 were different from list of 1992 to 2011.<sup>5</sup> *PLoS ONE* and *Medicine (United States)* became the leading two journals which were not in the leading list before 2011. *Journal of Trauma, Injury, Infection, and Critical Care* (publication end in 2011, continued by *Journal of Trauma and Acute Care Surgery*), *Journal of the Formosan Medical Association*, and *Clinical Toxicology* fell out of the top five non-EM journals list of 2012 to 2017. *PLoS ONE* and *Medicine (United States)* are open access, online-only, and multi-discipline journals that publication may obtain popularity due to broad scope and easy access. It is reasonable for researchers choosing to publish their researches on open access journals due to easily accessible to other researchers and thus maximize their research impact. This change also compatible with the rising trend of open access journals in biomedical field in recent decades.<sup>8</sup> Journals on trauma and toxicology fell out of the leading list represent the research topic change of

Taiwan emergency physicians. The postulate reasons of this phenomenon may be social economic structure transformation or traffic safety legislation improving<sup>9</sup> which needed further studies to clarify.

The leading journal categories between 2012 and 2017 were different from 1992 to 2011.<sup>5</sup> Medicine, General & Internal became the leading non-EM category. Surgery in the third place reflect trauma researches were not the leading research field in Taiwan EDs. Multidisciplinary Sciences in second place reflect the submission preference and increased publications in *PLoS ONE*. Infectious Diseases became the leading fourth category. The major research topics are related to drug resistant bacteria (*Acinetobacter*, *Methicillin-resistant Staphylococcus aureus*, *Klebsiella pneumoniae*) and antibiotics successibility, fresh water bacterial infections (*Aeromonas*), sepsis treatment and biomarkers such as procalcitonin, and viral infections including dengue fever, enterovirus, measles, and influenza infection. These topics reflect the increasing challenges to Taiwan EDs are both global and local. Advanced antibiotics use in sepsis patient and the following drug resistant bacteria are common in modern health care systems. Annual enterovirus endemic infection in Taiwan pose lots of pressure on first line acute care and public health system.

## Limitations

There were some limitations in this study. First, the contribution of first author from Taiwan EDs was analyzed in our study, and contributions by co-authors were not evaluated and may underestimate the overall academic contribution of Taiwan EDs. Second, the impact of publications was evaluated by cited times. The overall cited times were correlated with time since publication. The importance of recent publications may not be fully reflected from the perspective of cited times because the publications in our study were all within 6 years.

## Conclusions

The academic contribution by Taiwan EDs is continuous increasing in the past decades from the perspectives of quantity and breadth. These contribution has also been increasingly recognized by the global EM community and other medical specialties. The scientific publications analysis may provide a

continuous and dynamic evaluation of the development of EM specialty in addition to other milestones.

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**Supplement Table 1.** List of emergency medicine journals from the 2016 *Journal Citation Reports*

Emergency medicine journals	Language	Country	2016 impact factor	ISSN
<i>Annals of Emergency Medicine Resuscitation</i>	English	USA	5.352	1960644
<i>Emergencias</i>	Spanish	Spain	3.028	11376821
<i>Academic Emergency Medicine</i>	English	USA	2.925	10696563
<i>Prehospital Emergency Care</i>	English	USA	2.690	10903127
<i>World Journal of Emergency Surgery</i>	English	UK	2.282	17497922
<i>Scandinavian Journal of Trauma Resuscitation and Emergency Medicine</i>	English	UK	2.036	17577241
<i>European Journal of Emergency Medicine</i>	English	USA	2.025	9699546
<i>Injury-International Journal of The Care of The Injured</i>	English	UK	1.894	201383
<i>Emergency Medicine Journal</i>	English	UK	1.861	14720205
<i>American Journal of Emergency Medicine</i>	English	USA	1.494	7356757
<i>Emergency Medicine Australasia</i>	English	Australia	1.478	17426731
<i>Emergency Medicine Clinics of North America</i>	English	USA	1.360	7338627
<i>Canadian Journal of Emergency Medicine</i>	English	Canada	1.311	14818035
<i>Journal of Emergency Medicine</i>	English	USA	1.210	7364679
<i>Pediatric Emergency Care</i>	English	USA	1.034	7495161
<i>European Journal of Trauma and Emergency Surgery</i>	English	Germany	0.895	18639933
<i>Journal of Emergency Nursing</i>	English	USA	0.795	991767
<i>Notfall &amp; Rettungsmedizin</i>	German	Germany	0.529	14346222
<i>Ulusal Travma ve Acil Cerrahi Dergisi-Turkish Journal of Trauma and Emergency Surgery</i>	Turkish	Turkey	0.473	1306696X
<i>Unfallchirurg</i>	German	Germany	0.467	1775537
<i>Notarzt</i>	German	Germany	0.318	1772309
<i>Signa Vitae</i>	English	Croatia	0.136	13345605
<i>Hong Kong Journal of Emergency Medicine</i>	English	China	0.135	10249079