

## The Increase in the Number of Publications in the Field of Emergency Medicine: A 9-Year Analysis

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### Abstract

**Background:** The medical literature is ever-expanding, in terms of yearly number of published articles and in terms of number of medical journals. The current study tested the hypothesis that the number of publications in the field of Emergency Medicine increases over time in a linear fashion, and to verify whether the various types of medical manuscripts, as categorized by PubMed, follow the same pattern during 2003-2011.

**Methods:** Medline articles registered from 1/1/2003 until 12/31/2011 were incorporated, focusing on the fields of Emergency Medicine. The search was limited to the keywords "Emergency Medicine" or "Resuscitation" in the English language. Recorded were the number of all meta-analyses, clinical trials (CTs), randomized controlled trials (RCTs), editorials, letters to the Editor, practice guidelines, or reviews.

**Results:** During the evaluation period, PubMed reported 47,478 publications in Emergency Medicine. There was a significant linear increase in the total number of publications per year over the study period ( $R^2=0.981$ ,  $p<0.001$ ). When we considered the various categories of publications, there was a steady increase over time in meta-analyses ( $R^2 = 0.808$ ,  $p < 0.001$ ), reviews ( $R^2=0.62$ ,  $p=0.011$ ), clinical trials ( $R^2=0.887$ ,  $p<0.001$ ), RCTs ( $R^2=0.827$ ,  $p<0.001$ ), editorials ( $R^2=0.862$ ,  $p<0.001$ ), letters to the Editor ( $R^2=0.855$ ,  $p<0.001$ ), case reports ( $R^2=0.921$ ,  $p<0.001$ ), and practice guidelines ( $R^2=0.249$ ,  $p<0.001$ ).

**Conclusion:** There is a linear increase over time in the number of publications in the field of Emergency Medicine. Future computerized resources are to enable practitioners to better perform the task of improving and updating their knowledge, while still being able to perform their clinical duties.

**Keywords:** Emergency medicine; Resuscitation medicine; PubMed publications

medical manuscripts, as categorized by PubMed, follow the same pattern over the last 9 years.

### Introduction

The medical literature is ever expanding, both in terms of yearly number of published articles and in terms of number of medical journals [1]. Over the past few years, the emergence of open-access journals and the universalization of digital media have been noticeable [1]. Thus, it appears that in any given field of medical expertise, it may be an impossible task to read a significant portion of the published manuscripts.

Evidence-based medicine does not consider all types of medical manuscripts as equivalent in "strength" [2]. Critical reviews and meta-analyses based upon randomized controlled trials sit at the top of the evidence hierarchy, while case reports, editorials, or letters to the Editor probably sit at the other end [3]. In previous studies related to fields as diverse as Neonatology [4], Dermatology [5], or Ear Nose and Throat [6], we have shown that the yearly number of most types of publications increases over time, but not necessarily in the same pattern according to the category of article considered.

The aim of the current study was to test the hypothesis that the number of publications in the field of Emergency Medicine increases over time in a linear fashion, and to verify whether the various types of

### Methods

We used the Internet address: <http://www.ncbi.nlm.nih.gov/entrez> in order to collect all Medline articles registered from 1/1/2003 until 12/31/2011. We focused on the fields of emergency medicine, intending to retrieve as many emergency medicine related articles as possible. To fulfill this aim, we limited the search, using PubMed's own Limits engine to the following keywords: "Emergency Medicine" or "Resuscitation". We limited the publications to those written in English.

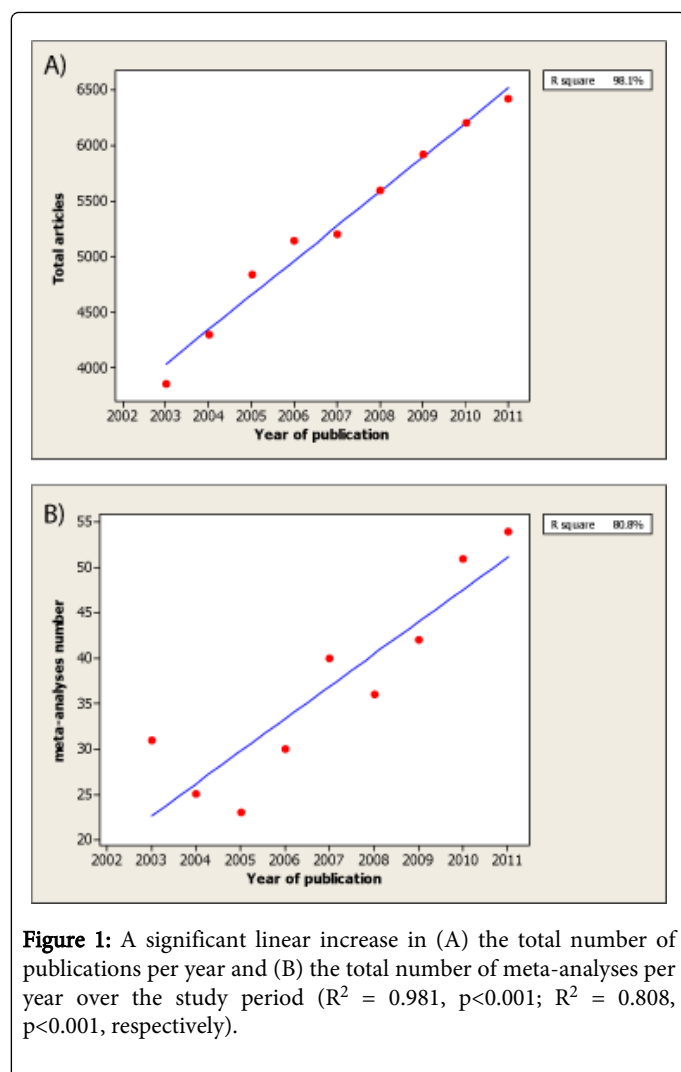
The search was repeated each time using one limit according to the category of publication, and we recorded the total number of publications per year. Using PubMed's own article classification system, we recorded the number of all meta-analyses, clinical trials (CTs), randomized controlled trials (RCTs), editorials, letters to the Editor, practice guidelines, or reviews. For each year, we used a random sample of 10 studies, and found that in 100 % of cases, PubMed classification was accurate.

We used the Minitab version 16.1 (State College, PA) for statistical analyses. Regression analysis was applied to study the effect of

advancing year of publication upon the number of publications of each type. A P-value of <0.05 was considered significant.

## Results

During the evaluation period, PubMed reported 47,478 publications in Emergency Medicine (as various categories of publications, there was a steady increase over time in meta-analyses ( $R^2 = 0.808$ ,  $p < 0.001$ , Figure 1B), reviews ( $R^2 = 0.62$ ,  $p = 0.011$ ), clinical trials ( $R^2 = 0.887$ ,  $p < 0.001$ ), RCTs ( $R^2 = 0.827$ ,  $p < 0.001$ ), editorials ( $R^2 = 0.862$ ,  $p < 0.001$ ), letters to the Editor ( $R^2 = 0.855$ ,  $p < 0.001$ ), case reports ( $R^2 = 0.921$ ,  $p < 0.001$ ), and practice guidelines ( $R^2 = 0.249$ ,  $p < 0.001$ , defined in the methods section). There was a significant linear increase in the total number of publications per year over the study period ( $R^2 = 0.981$ ,  $p < 0.001$ , Figure 1A). When we considered the various categories of publications, there was a steady increase over time in meta-analyses ( $R^2 = 0.808$ ,  $p < 0.001$ ; Figure 1B), reviews ( $R^2 = 0.62$ ,  $p = 0.011$ ), clinical trials ( $R^2 = 0.887$ ,  $p < 0.001$ ), RCTs ( $R^2 = 0.827$ ,  $p < 0.001$ ), editorials ( $R^2 = 0.862$ ,  $p < 0.001$ ), letters to the Editor ( $R^2 = 0.855$ ,  $p < 0.001$ ), case reports ( $R^2 = 0.921$ ,  $p < 0.001$ ), and practice guidelines ( $R^2 = 0.249$ ,  $p < 0.001$ ).



**Figure 1:** A significant linear increase in (A) the total number of publications per year and (B) the total number of meta-analyses per year over the study period ( $R^2 = 0.981$ ,  $p < 0.001$ ;  $R^2 = 0.808$ ,  $p < 0.001$ , respectively).

When considered by type of articles, the rate of increase in the yearly number of articles was not completely similar between all types

of articles considered: indeed, during the 9 - year study period, the total number of articles increased from approximately 4000 per year in 2003 to approximately 6500 in 2011 (an increase by a factor of 1.6). During the same period of time, the number of clinical trials per year increased from approximately 425 to approximately 650 (an increase by a factor of 1.5); the number of editorials increased from approximately 110 per year to 240 (an increase by a factor of 2.2); the number of letters increased from 180 per year to 300 per year (an increase by a factor of 1.7); meta-analyses increased from approximately 22 per year to 50 (an increase by a factor of 2.3); the number of practice guidelines increased from approximately 30 per year to approximately 70 (an increase by a factor of 2.3). The number of RCTs increased from approximately 210 to approximately 250 (an increase by a factor of 1.2); the number of case reports increased from approximately 700 to approximately 1000 (an increase by a factor of 1.4); the number of reviews rose from approximately 900 per year to 1100 per year (an increase by a factor of 1.2).

## Discussion

We verified our hypothesis that there is a linear increase over time in the number of publications that the emergency physician, who wishes to keep updated with current medical literature, has to read.

The fact that the number of articles increases over time is dependent upon multiple factors. Among them, the ever increasing world population, thus the increasing number of physicians and investigators [7]; the extraordinary developments of the pharmaceutical industry with development of new classes of drugs (in particular the biological ones) [8]; the increased accessibility of literature search engines; and the ever increasing number of medical journals, in particular the so called "open access, internet-based" ones [1]. These journals have created a real revolution in the field of medical publishing, raising also the question of whether quality equals quantity [1]. Indeed, more research papers do not necessarily equate to better research. When there is limited room for publishing articles, editors are likely to select only the very best ones. In contrast, when the number of journals increases every year (leaving room for more articles to be published), and when there is a financial incentive for open access journals to publish articles (there is a contributor fee levied by these journals) there is a risk that poor quality studies get published with a greater ease than in the past.

When we look at the strength of evidence that a given article has, at the bottom are case reports, editorials and letters to the editor, while at the top we find systematic reviews and meta-analyses of randomized clinical controlled trials. From our study, it appears that there was no consistent trend in the field of emergency medicine. Indeed, while the yearly total number of articles increased approximately by a factor of 1.6 during the 9-year period, case reports, editorials and letters to the editor (the "lower quality articles") increased respectively by a factor of 1.4, 2.2, and 1.7. As to the higher quality articles, meta-analyses increased by a 2.2 factor, while RCTs increased by a disappointing factor of only 1.2.

It appears from our study that the number of publications in the field of Emergency Medicine increased over time, but this needs to be understood in the context of other fields of medicine, since there is a parallel increase in all the medical literature. This issue has been dealt with in fields as diverse as dermatology [5], otolaryngology [11], ophthalmology [12], pediatrics [4], and neonatology [4]. It appears that not all fields have identical trends. From our study, it appears that

the increase in the yearly number of clinical guidelines in emergency medicine is uniquely vast. This might be due to the fact that the field of emergency medicine is in need – maybe more than any other field - of clinical guidelines that allow prompt recognition of medical conditions and quick, systematic and efficient approach thereto. Currently, 70 clinical guidelines are published annually, a substantial increase compared to the 30 guideline published 9 years ago.

In the context of the growing number of publications in the field of emergency medicine, it would be apposite to consider the merits and expertise of the authors upon focusing on specific manuscripts. The productivity of publishing academic emergency physicians (AEP) may be characterized using the h-index [9,10], by counting the number of publications by an author, ranked in descending order by number of citations, until the paper number equals the number of citations. DeLuca et al. [10] recently reported that 85% of AEP had h-indices less than six, 95% less than 13 and 99% less than 24. Additionally, an (h-index)/(years in publication) ratio of 0.5 or greater is characteristic of the most productive emergency physicians and represents only 10% of all AEPs [10]. Accordingly, the h-index may be used as an efficient tool for prioritizing manuscript reading.

We confirm that there is an overwhelming amount of published articles in the field of emergency medicine every year, and that their number appears to be ever increasing. Critical appraisal, dissemination and application of the information gathered are a daunting task. It has been suggested by some to obtain resources for medical information based upon the question asked [3]. The so called "6 S Hierarchy" classifies resources for clinical information according to an evidence based model of importance [3]. At the base of the pyramid there are "Studies" (the first S) that require to be read on our own, a tedious and time consuming task. Above studies are Synopses of Studies (the second S) which consist of a summary of single studies (usually those of higher quality) already selected and summarized for the reader and commented in order to help interpret the findings. Above this level are Syntheses (the third S) which consist of systematic reviews (with or without meta-analyses) and allow for the integration of existing information, the verification of the consistency of findings and of outcomes, and the reduction of random biases of single studies by using meta-analytic methods. Above Syntheses, Synopses of Syntheses are found which provide a summary of asystematic review with clinical implications. The concern with Synopses of Syntheses is that they take time to be conducted and therefore may not be current. Above this step are Summaries that provide the level of evidence of a particular strategy. These summaries need to be updated, as evidence may change over time. Finally, the sixth S of the hierarchy, sitting on the top of the pyramid, refers to Systems. Systems are based on electronic health records that have computerized decision making abilities that enable them to make up-to-date and evidence-based decisions for each patient in real-time.

Theoretically, the task of carefully reading and analyzing 6500 articles per year in this particular field of medicine (and we do not claim that our search key words allowed to find all emergency medicine related articles) requires critically reading an average of 18 articles per day, a task that would probably prohibit the practice of medical care for multiple hours. In the future, computerized resources such as the ones described in the "6 S Hierarchy" should enable practitioners to better perform the task of improving and updating their knowledge, while still being able to perform their clinical duties.

It would important in future studies to explore the distribution of investigated topics within the field of emergency medicine as well as the evolution of their quality. Additionally, it would be pertinent to develop tools, such as the h-index, that allow the prioritization of articles to enable emergency specialist physicians keep abreast with current developments in their field of expertise.

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