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### **Western Journal of Emergency Medicine: Integrating Emergency Care with Population Health**

#### **Title**

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#### **Permalink**

<https://escholarship.org/uc/item/465609c5>

#### **Journal**

Western Journal of Emergency Medicine: Integrating Emergency Care with Population Health, 13(4)

#### **ISSN**

1936-900X

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#### **Publication Date**

2012

#### **DOI**

10.5811/westjem.2011.6.6722

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Peer reviewed

# Emergency Physicians Research Common Problems in Proportion to their Frequency

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Supervising Section Editor: Michael Epter, DO

Submission history: Submitted February 2, 2011; Revision received May 31, 2011; Accepted June 22, 2011

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DOI: 10.5811/westjem.2011.6.6722

**Introduction:** Emergency medicine (EM) organizations such as the Society for Academic Emergency Medicine and the Institute of Medicine have called for more clinical research as a way of addressing the scarcity of research in EM. Previous investigations have examined funding and productivity in EM research, but whether EM researchers preferentially concentrate on certain patient-related topics is not known. We hypothesized that at least part of the scarcity of EM research is from the tendency of EM researchers, like researchers in other fields, to focus on rarer conditions with higher morbidity or mortality instead of on more common conditions with less acuity. This study compared the frequency of specific medical conditions presenting to emergency departments nationwide with the frequency of emergency physician research on those same conditions.

**Methods:** This study is a structured retrospective review and comparison of 2 databases during an 11-year span. Principal diagnoses made by emergency physicians as reported by the National Hospital Ambulatory Medical Care Survey were compared to all first-author publications by emergency physicians as reported in PubMed between 1996 and 2006. Statistics included correlations and linear regression with the number of emergency department (ED) visits per diagnosis as the independent variable and the number of articles published as the dependent variable.

**Results:** During the study period, there was significant concordance between the frequency of presenting conditions in the emergency department and the frequency of research being performed on those conditions, with a high correlation of 0.85 ( $P < 0.01$ ). More common ED diagnoses such as injury/poisoning, symptoms/ill-defined conditions, and diseases of the respiratory system accounted for 60.9% of ED principal diagnoses and 50.2% of the total research published in PubMed.

**Conclusion:** Unlike researchers in other fields, emergency physicians investigate clinical problems in almost the exact proportion as those conditions are encountered in the emergency department. The scarcity of EM research does not have to do with a skewed focus toward less common patient problems. [West J Emerg Med. Year;00(0):000–000.]

## INTRODUCTION

Published research from the United States in the field of emergency medicine (EM) is rapidly increasing. Between 1996 and 2005, the United States published 58.5% of the world's EM research and also experienced the fastest publication growth of any country.<sup>1</sup> Not surprisingly, the

number of EM journals has also rapidly increased. Since becoming a board-certified specialty in 1979, the number of EM journals officially tracked by Thompson Scientific Journal Citation Reports has grown from 5 to 13, with many more “unofficial” journals that have not yet achieved mainstream status.<sup>2</sup> This was paralleled by a 20% increase in

emergency department visits in the United States, up from 96.5 million in 1996 to 115.3 million in 2005.<sup>3</sup>

Previous investigations have examined funding and productivity in EM research, but whether EM physicians preferentially concentrate on certain patient-related topics is not known.<sup>4-7</sup> There are reasons to doubt that EM researchers concentrate on common patient problems. First, EM researchers who are funded by the National Institutes of Health (NIH) are presumably focused on patient problems that the NIH has labeled as high priority, regardless of how commonly these patient problems are found in the emergency department. Second, successful NIH funding requires a focused niche of research, and mentorship in common EM problems may be lacking. Finally, EM researchers may behave similarly to researchers in other fields, such as neurology, in which researchers concentrate their efforts on rarer conditions with higher morbidity and mortality.<sup>8</sup>

This study seeks to assess the relationship between frequency of specific medical conditions presenting to the emergency department and the specific areas of research being performed by emergency physicians. As there is no literature on which to predict a relationship, we hypothesized that EM researchers, like researchers in other fields, would focus a disproportionate amount of research effort on rarer conditions.

## METHODS

### Study Design

This was a retrospective analysis of publicly available data and was thus exempt from institutional review board approval. Data were obtained from the National Hospital Ambulatory Medical Care Survey (NHAMCS), a long-running, federally sponsored survey of hospital emergency department utilization conducted by the US Centers for Disease Control and Prevention (CDC). The NHAMCS study is a study of nationwide emergency department utilization that uses a 4-stage probability sample of all in-person visits to nonfederal short-stay hospitals. It includes only emergency departments that are open 24 hours a day. Further information about the sampling procedure is available at [http://www.cdc.gov/nchs/ahcd/ahcd\\_scope.htm](http://www.cdc.gov/nchs/ahcd/ahcd_scope.htm) (accessed November 19, 2011). Briefly, however, the sampling procedure designed by the CDC samples geographic areas, hospital and emergency departments within geographic areas, emergency service areas within emergency departments, and the patient visits by emergency service areas. All data on the estimated number of primary diagnoses were obtained from published data in NHAMCS surveys for years 1996–2006, and no attempt was further made to subdivide or categorize them.<sup>9-19</sup> These diagnoses are based on the International Classification of Diseases – 9th revision system of classification. In the years that the standard error was reported, which is an estimate of the error involved in the number of visits, this was less than or equal to 0.5%.<sup>12-19</sup>

Each diagnosis was then associated with relevant articles from Medline. Selection methods of articles from PubMed for

this type of research have been previously reported.<sup>1</sup> EM articles published by US emergency physicians from 1996–2006 were identified from the US National Library of Medicine's Medline database by using the institutional affiliation of the first author, a standard field in bibliographic citations. The affiliation contains the author's department, institution, city, state, and country. Affiliations that contained the word "emergency" were considered to originate from EM departments.

Using only the first author's affiliation for determination of clinical department and country of origin can be potentially problematic in instances in which authors from multiple departments or multiple countries collaborate. Excluding non-first authors could potentially undercount the contributions of these authors. On the other hand, assigning non-first authors full credit could overestimate their contributions. Undeserved, or "honorary" authorship is a problem in the EM literature, as well as the general medical literature, where up to 19% of articles have honorary authors.<sup>20,21</sup> In major articles, the first authors account for a preponderance of work and are most deserving of credit.<sup>22,23</sup> Additionally, 98.9% of first authors meet the International Committee of Medical Journal Editors criteria for authorship versus only 52.8% for middle authors.<sup>24</sup> Therefore, we concluded that using the institution affiliation for the first authors was the best compromise.

Determination of article topic was achieved using medical subject headings (MeSH) terms. MeSH terms are created and assigned by the US National Library of Medicine (NLM) for the sole purpose of creating standardized labels pertaining to the subject matter of articles and permitting search for articles at various levels of specificity.<sup>25,26</sup> There is evidence that searching in Medline using MeSH terms retrieves more relevant articles than searching for articles with free text.<sup>27</sup> Additionally, MeSH terms allow article identification with a limited set of standardized vocabulary. Use of free text to search for articles, in contrast, uses a virtually unlimited set of nonstandardized vocabulary, and as such, runs the risk of including irrelevant articles and missing appropriate articles. MeSH terms are assigned by indexing staff at the NLM, using standardized procedures.<sup>28</sup> Although this assignment is done by hand, the NLM uses computerized programs to check for errors before the record is included in Medline.<sup>29</sup>

Before any data were collected, relevant MeSH headings were associated with diagnoses reported by the NHAMCS, as shown in Table 1. All search terms within a given MeSH tree hierarchy (see Figure 1 for example) were associated with the MeSH term at the highest level possible. However, since articles in Medline are generally assigned an average of 10 to 12 MeSH descriptors each, articles could be associated with more than 1 emergency department diagnosis.<sup>28</sup> This follows Medline classification, and no attempt was made to classify articles as being predominantly more about 1 topic than another. All articles associated with a particular emergency department diagnosis, however, were counted only once.

**Table 1.** A listing of emergency department diagnoses and their associated MeSH (medical subject headings) used in the study.\*

Emergency department diagnosis	MeSH
Infectious and parasitic diseases	C1. Bacterial infections and mycoses C2. Virus diseases C3. Parasitic diseases
Neoplasms	C4. Neoplasms
Endocrine, nutritional, metabolic diseases, immunity disorders	C15. Hemic and lymphatic diseases C18. Nutritional and metabolic diseases C19. Endocrine system diseases C20. Immune system diseases
Mental disorders	F3. Mental disorders
Diseases of nervous system and sense organs	C9. Otorhinolaryngologic diseases C10. Nervous system diseases C11. Eye diseases
Diseases of the circulatory system	C14. Cardiovascular diseases
Diseases of the respiratory system	C8. Respiratory tract diseases
Diseases of the digestive system	C6. Digestive diseases C7. Stomatognathic diseases
Disease of the genitourinary system	C12. Male urogenital diseases C13. Female urogenital diseases and pregnancy complications
Diseases of skin and subcutaneous tissue	C17.800. Skin diseases
Diseases of musculoskeletal system and connective tissue	C17.300. Connective tissue diseases C5. Musculoskeletal diseases
Symptoms, signs, ill-defined conditions	C23. Pathologic conditions, signs, and symptoms
Injury and poisoning	C21. Disorders of environmental origin D26. Pharmaceutical preparations D27. Chemical actions and uses

\* Articles associated with a particular emergency department diagnosis were only counted once for each diagnosis. Please see text for explanation.

As there is always a lag between conception of an idea in a clinical setting and the publication of an article based on this idea, averages based on 11 years of data were included in the study. Statistics were calculated by using the Systat13 package (Cranes Software, Chicago, Illinois) and Microsoft Excel 2007 (Redmond, Washington).

### Primary Data Analysis

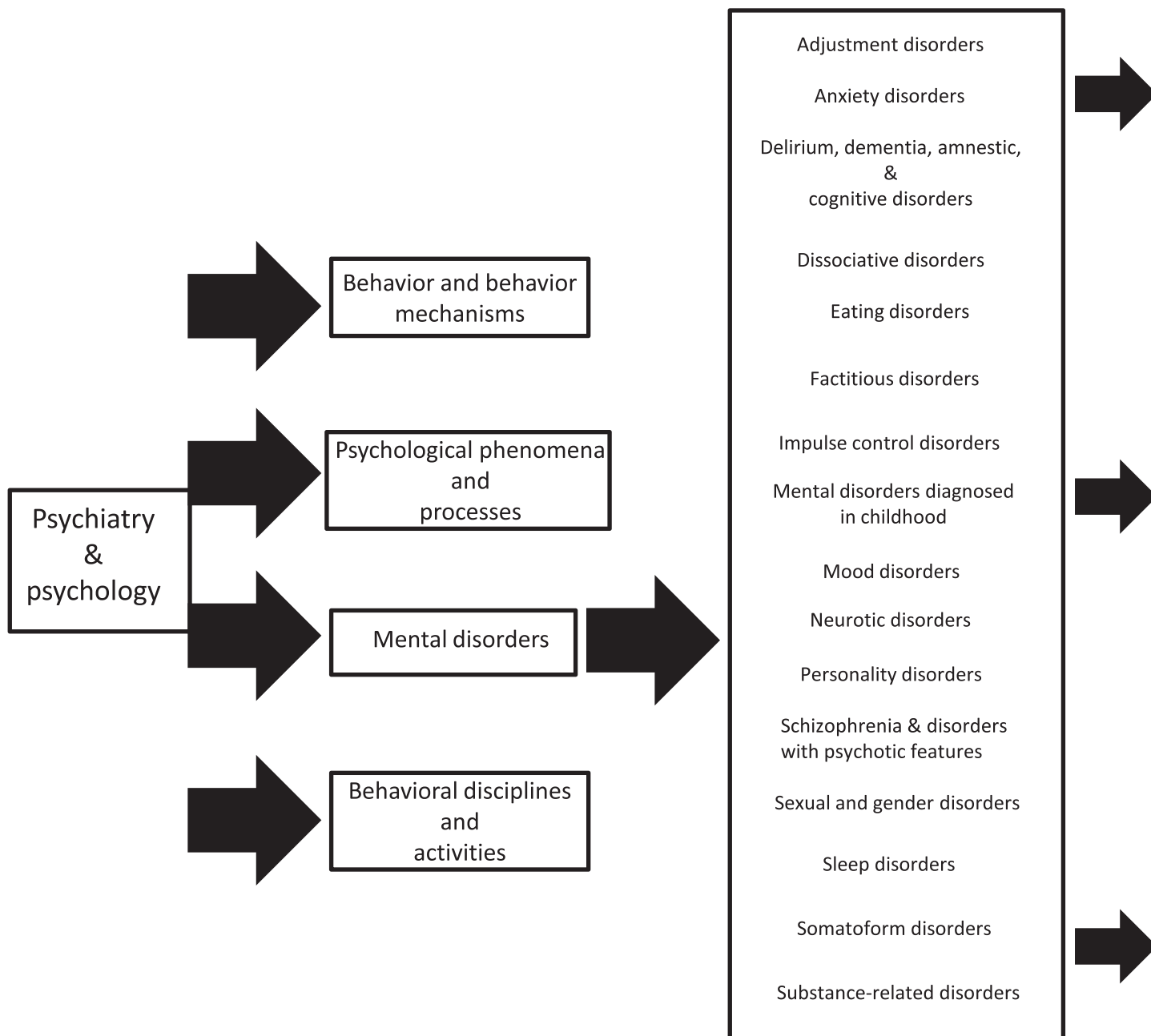
The primary outcome measure of this study was a correlation between the average number of diagnoses made by emergency department physicians in the years 1996–2006, as reported by the NHAMCS, and the average number of first-authored articles per year for each diagnosis, as listed on Medline. The Systat 13 statistical software package was used for all comparisons.

### RESULTS

Using the above methodology, 9,690 articles were included in the study. These articles were from 499 unique journals. The

CDC data indicated that there were 119.2 million visits to emergency departments in 2006, up from 90.3 million visits in 1996.

During the study period, the most common diagnosis resulting in an emergency department visit was “injury and poisonings.” This was also the most common research topic investigated by emergency physicians (please see Figure 2 and Table 2). Across diagnoses, there was a high level of concordance between the frequency of the diagnosis in the emergency department and the frequency of first-author publications, with a simple correlation of 0.85 ( $P < 0.01$ ). In a linear regression analysis, using ED diagnoses as the independent variable and number of articles published as the dependent variable, the number of emergency department diagnoses significantly predicted the number of first-author publications ( $b = 0.85$ ,  $r^2 = 0.72$ ,  $t_{11} = 5.3$ ,  $P < 0.01$ ). The most common emergency department diagnoses, such as injury/poisoning, symptoms/ill-defined conditions, and diseases of the respiratory system, accounted for 60.9% of ED principal



**Figure 1.** An example of the medical subject heading classification scheme for the term *psychiatry and psychology*. For reasons of space, classification is arbitrarily truncated at the third level of specificity (please see the Appendix, online only). Articles associated with any search term in the tree were associated at the highest level possible, in this instance, *mental disorders*.

diagnoses and 50.2% of the total research published in Medline during the same period. The least common diagnosis, neoplasms, accounted for 0.2% of all ED diagnoses and 0.8% of all published research.

**DISCUSSION**

Emergency physicians research common patient conditions almost in the exact proportion with which these diagnoses are encountered in the emergency department. This is an unexpected finding, since anecdotal reports and scant

research from other fields suggests that researchers in general tend to concentrate on conditions that are only rarely encountered by the average practicing physician. This finding also suggests that the scarcity of EM research does not have to do with misallocation of research resources to less common patient problems.

If EM researchers, when they do perform research, tend to concentrate on patient-oriented problems, why then is there such a scarcity of EM research overall? Although this question was not directly addressed in this study, previous investigations

**Table 2.** A comparison of emergency department (ED) visits categorized by primary physician diagnosis with first-author publications by emergency medicine researchers, averaged for years 1996–2006.

	ED diagnoses per year, No.	Articles published per year, No.
Injury and poisoning	29,197	276
Symptoms, signs, ill-defined conditions	18,265	186
Diseases of the respiratory system	12,507	71
Diseases of the digestive system	6,243	31
Diseases of the nervous system	5,757	119
Diseases of the musculoskeletal system	5,704	15
Diseases of the genitourinary system	4,765	31
Diseases of the circulatory system	4,313	140
Mental disorders	3,423	31
Diseases of the skin and SQ tissue	3,292	11
Infectious and parasitic diseases	3,211	70
Endocrine, nutritional, metabolic diseases	1,592	69
Neoplasms	266	11
All other	8,077	309

SQ, subcutaneous.

have implicated a lack of NIH funding, as this is the largest contributor to biomedical funding. In a 2007 article, Wilson and Itagaki<sup>1</sup> examined the number of all first-authored articles on Medline from 1996–2005. NIH-funded articles are required to acknowledge this funding on Medline, thus making it possible to track the percentage of NIH-funded articles over time. This study found that an average of 4.5% of all EM articles from 1996–2005 reported receiving NIH grants, with approximately 6.6% of all first-authored EM articles in 2005 and approximately 8.1% of all first-authored EM articles in 2006 reporting funding. Despite the positive growth of NIH funding during the past decade, more than 90% of all EM research is unfunded, with all of the difficulties inherent in trying to sustain a research program without funding.

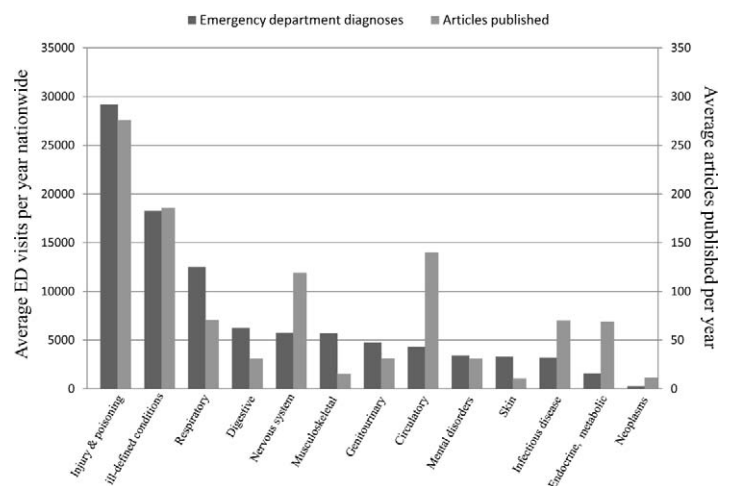
More controversially, these findings suggest that if the scarcity of EM research does not have to do with the misallocation of research resources, then current NIH efforts to focus research on specific EM conditions may be misguided.<sup>30</sup> Such well-intentioned initiatives may lead to funding for less common patient care conditions instead of more common ones, or may continue to promote research in areas that are already overrepresented. Instead, support should be given for improving emergency research more generally.

### LIMITATIONS

This study has a number of important limitations. First, the results reported here are limited by the nature of the Medline index itself. Medline does not index all of the available world literature, containing only approximately 5,200 journals selected by the US National Library of Medicine. A search of Medline for EM articles will therefore have missed abstracts not available on this system, which may be more common for

non-English citations.<sup>31</sup> However, given that this study investigated US articles only, this should not influence the results found here. The methodology reported here will also have missed publications from emergency physicians who, by virtue of working in another area of the hospital, do not explicitly include the word “emergency” in their affiliation.

Second, this study rests on an important assumption, namely that the frequency of a presenting condition can be accurately assessed from the final diagnosis listed on the chart. This assumption is further limited by the nature of the categories created by both the National Hospital Ambulatory Care Study and Medline. NHAMCS categories were not constructed by the authors of this article, and the CDC study



**Figure 2.** A comparison of articles published in PubMed by emergency medicine physicians on a particular diagnosis, averaged for years 1996–2006. ED, emergency department.

makes no allowance for physician error in diagnosis. In addition, to the extent that any sampling bias existed in the original NHAMCS study, which relies on a complicated statistical sampling procedure to derive these data, our estimate of the prevalence of physician diagnoses is incorrect. Furthermore, Medline categories were also not created by physicians, and any systematic indexing error on the part of the US National Library of Medicine could lead to error. This is also true of any error in our mapping of NHAMCS diagnoses to MeSH terms, 2 systems of classification that were not concurrently designed.

Finally, data from the National Hospital Ambulatory Care Survey concern diagnoses of disease only. Thus, the vast body of research published by emergency physicians on topics such as emergency medical services and patient flow is not captured by this methodology. This study is therefore limited to assessments of patient-oriented research only; more specifically, it is limited to the kinds of patient-oriented problems commonly diagnosed by emergency physicians.

Of note, the assignment of multiple MeSH terms to a particular article is not a limitation of this study for 2 reasons. First, articles were only counted once for each relevant emergency department diagnosis. Second, if an article concerns more than 1 potential emergency department diagnosis, it deserves to legitimately be counted in each category.

## CONCLUSION

Unlike researchers in other fields, such as neurology, emergency physicians investigate clinical problems in almost the exact proportion as those conditions are encountered in the emergency department. The scarcity of EM research does not have to do with a skewed focus toward less common patient problems.

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*Conflicts of Interest:* By the *WestJEM* article submission agreement, all authors are required to disclose all affiliations, funding, sources, and financial or management relationships that could be perceived as potential sources of bias. The authors disclosed none.

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