

Research Article

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Interest in Anesthesia as Reflected by Keyword Searches using Common Search Engines

Renyu Liu^{1*}, Paul S. García² and Lee A. Fleisher¹

¹Department of Anesthesiology and Critical Care, Perelman School of Medicine at the University of Pennsylvania

²Department of Anesthesiology, Atlanta VA Medical Center, Emory University School of Medicine

Abstract

Background: Since current general interest in anesthesia is unknown, we analyzed internet keyword searches to gauge general interest in anesthesia in comparison with surgery and pain.

Methods: The trend of keyword searches from 2004 to 2010 related to anesthesia and anaesthesia was investigated using Google Insights for Search. The trend of number of peer reviewed articles on anesthesia cited on PubMed and Medline from 2004 to 2010 was investigated. The average cost on advertising on anesthesia, surgery and pain was estimated using Google AdWords. Searching results in other common search engines were also analyzed. Correlation between year and relative number of searches was determined with $p < 0.05$ considered statistically significant.

Results: Searches for the keyword "anesthesia" or "anaesthesia" diminished since 2004 reflected by Google Insights for Search ($p < 0.05$). The search for "anesthesia side effects" is trending up over the same time period while the search for "anesthesia and safety" is trending down. The search phrase "before anesthesia" is searched more frequently than "preanesthesia" and the search for "before anesthesia" is trending up. Using "pain" as a keyword is steadily increasing over the years indicated. While different search engines may provide different total number of searching results (available posts), the ratios of searching results between some common keywords related to perioperative care are comparable, indicating similar trend. The peer reviewed manuscripts on "anesthesia" and the proportion of papers on "anesthesia and outcome" are trending up. Estimates for spending of advertising dollars are less for anesthesia-related terms when compared to that for pain or surgery due to relative smaller number of searching traffic.

Conclusions: General interest in anesthesia (anaesthesia) as measured by internet searches appears to be decreasing. Pain, preanesthesia evaluation, anesthesia and outcome and side effects of anesthesia are the critical areas that anesthesiologists should focus on to address the increasing concerns.

Keywords: Anesthesia; Inquiry data; Pain; Side effects; Pain; Internet search engine

Introduction

Advances in the field of anesthesiology in the past five decades have paved the way for many different complex invasive surgeries and procedures on patients with complicated health conditions and comorbidities. At the same time, anesthesiologists have and continue to expand their role in the hospital setting. While all perform the traditional role of providing care in the operating room, an increasing number are also branching into non-operating room procedural settings (i.e. endoscopy suite, radiology suite, cardiac electrophysiology suite etc). Despite this increasing involvement, the interaction between the anesthesiologist and both the conscious patient and his or her family members remains brief and is mostly limited to the preoperative interview, intensive care unit and the topic of pain management. Therefore, anesthesiologists are afforded limited opportunities to educate their patients about the contribution of perioperative care from the anesthesia team to the overall outcome.

It is common for the majority of the limited preoperative time to be spent on gathering critical preoperative information and explaining potential risks related to anesthesia. Thus, the vital contribution of anesthesiologists to a patient's outcome during the perioperative or periprocedural period remains unclear to the public. Published studies clearly indicate that the patient's perspective on outcome seems to be limited to unpleasant experiences (including nausea, vomiting and pain etc) during the perioperative period [1]. Similar items were also included on the list of concerns from expert anesthesiologists [2].

It is conceivable that general concern regarding the safety of anesthesia might have decreased with the improvements in the safe administration of anesthetics [3-5]. However, the increasing number of anesthetic cases performed each year and the expansion of anesthesia service beyond the operating room may lead patients and patients' family members to seek more information about anesthesia medications (and their potential unintended effects) and/or about their anesthesiologist. This information may not be routinely provided before a patient is scheduled for a procedure. Therefore patients might seek answers to their questions through alternative means (word-of-mouth, hospital reputation or online resources). Given the diversity of these alternative means, the current general perception related to anesthesia and the specific major concerns of our patients and patient family members regarding anesthesia are unknown and need to be investigated.

***Corresponding author:** Renyu Liu, Assistant Professor, Department of Anesthesiology and Critical Care, Perelman School of Medicine at the University of Pennsylvania, 3620 Hamilton Walk, 336 John Morgan Building, Philadelphia, PA 19104, USA, Tel: 2156623750; Fax: 2153495078; E-mail: liur@uphs.upenn.edu

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Given that trends in general interest are likely mirrored in internet search activity and that Google Insights for Search has been used successfully for research in a variety of clinical disciplines [6-10] we hypothesized that the changes in public interest/concern on elements of perioperative care related to anesthesia/analgesia and surgery could be reflected by data available in internet including the trend of searching, the available internet posting and peer reviewed article and estimated cost for advertisement related to anesthesiology. Various online search engines (Bing, Yahoo, Google, Webmed, PubMed and Medline) and Google's associated resources: Google Insights for Search and Google AdWords were queried to trend keyword searches related to anesthesia, to compare different hits in different search engines and to estimate the cost of advertisement on anesthesia, surgery and pain related websites in order.

Materials and Methods

The investigators requested acknowledgment of the Internal Review Board at the University of Pennsylvania of the protocol.

The development of modern information management has allowed individuals to seek information by entering certain keywords into searchable online databases which provide links to other web pages matched by relevancy algorithms. Statistics related to any specific website based on the number of queries, if the number of visits, can be obtained. Two recently available tools from Google (Google Insights for Search and Google AdWords) allow for the investigation of the trend for any keywords or combination of keywords and the estimated costs for advertisement. These services are useful for business purposes, especially to guide investors and policy makers in understanding the current trends including top searches.

The trend in keyword search reflected by google insights for search

The Google search engine is the most common internet search engine to assess postings by various sources related to a specific subject matter. Google Insights for Search (<http://www.google.com/insights/search/#>) allows any individual to compare search volume patterns across specific categories, regions, time frames and properties. Google Insights for Search does not reveal how many existing web pages are related to a subject but how many times certain keywords have been entered on the main Google web page. We assessed the searching trends for the following terms for the years 2004-2011: anesthesia, anesthesia and safety, anesthesia side effects, anesthesiologist, surgery, surgeon, pain, pain after surgery. The reliability of the trend of the Google query data has been tested by its provider and end users and this tool has been successfully applied in medical research [11-14]. The numerical results from Google Insights for Search are shown over time but are not indicative of actual number of entered keyword searches. Trends over time are represented as a scaled number (1-100) normalized to the time of maximal search activity (100) for those particular keywords.

While it would be ideal to obtain the trend of search using other search engines for comparison purposes, Google is the only engine that could provide meaningful data for more than one year from 2004.

The trend of available literature in pubmed and medline

To search peer reviewed biomedical literature, PubMed (<http://www.ncbi.nlm.nih.gov/pubmed/>) and Medline (OVID) (<http://ovidsp.ovid.com/>), was used. Endnote X4 (Thomson Reuters, San Francisco, CA) was applied as a search tool by selecting PubMed because Endnote can provide the number of publications in PubMed in a given year.

The same keywords for Google search were used for the peer reviewed literature search for the trend of research related to anesthesia from 2004 to 2010.

The searching results (number of hits) in different searching engines

The availability of posting (number of hits) for the keywords related to perioperative patient care was investigated and compared using Google, Yahoo (www.yahoo.com), Bing (<http://www.bing.com>), PubMed and WebMD (<http://www.webmd.com>). The same key word was inputted into various search engines and the total hits were recorded. The ratio of the numbers of hits within the same search engine was calculated.

Estimated advertising cost on anesthesia, surgery and pain

Google AdWords (<http://www.google.com/ads/adwords2/>) is the major source of revenue for Google, Inc. Its main feature is that businesses can pay to be a "sponsored-site" listed to the right of the search results after a potential customer enters specific keywords. Potential advertisers can bid on being listed to the right of a Google search result of the most popularly searched keywords. Thus, the estimated average cost for advertisement related to specific Google keyword searches can be obtained through this service. Three key words related to anesthesia care had sufficient utilization to generate AdWords data: anesthesia, surgery and pain. Numerical results from AdWords are estimates of the number of monthly searches by geographical region (based on data available) and costs (in USD) of advertising.

Statistical analysis

Prism 5 for Windows (V 5.02, GraphPad Software, La Jolla, CA) was used for statistical analysis. The correlation between the normalized number (%) of query data in Google in a given year and the year (year 2004 as year one and plus one for each subsequent year) was performed using linear or non-linear regression, when appropriate. The correlation between the normalized number (%) of literature on a specific category against the total number of literature for anesthesia in PubMed in a given year and the year (year 2004 as year one and plus one for each subsequent year) was performed. If an exponential correlation was indicated, the coefficient of determination (R^2) was determined. An alpha level of $p < 0.05$ was considered statistically significant.

Results

The trend of the query data

Anesthesia, Safety and Side Effects: The data demonstrated a gradual decrease over time for the key word "anesthesia" (Figure 1, left panel). Similar result is obtained for the key word of "anaesthesia" (data not shown). A correlation analysis between the normalized number (%) of query data in Google for every January in a given year and the year (year 2004 as year one and plus one for each subsequent year) clearly indicated an exponential decrease for either "anesthesia" or "anaesthesia" ($R^2=0.99$ for anesthesia and $R^2=0.97$ for anaesthesia; Figure 1, right panel). Similarly, the search for "anesthesia safety" has exhibited a steady decline, though the search for "anesthesia side effects" is trending up in recent years (Figure 2).

Anesthesia vs. surgery and anesthesiologist vs. surgeon: While searches for "anesthesia" or "anaesthesia" as a keyword have gradually decreased over time (Figure 1), searches for "surgery" have remained constant during the same time period (Figure 3). However, the absolute number of searches for "surgery" is much greater than

Interest Over Time for ‘anesthesia’

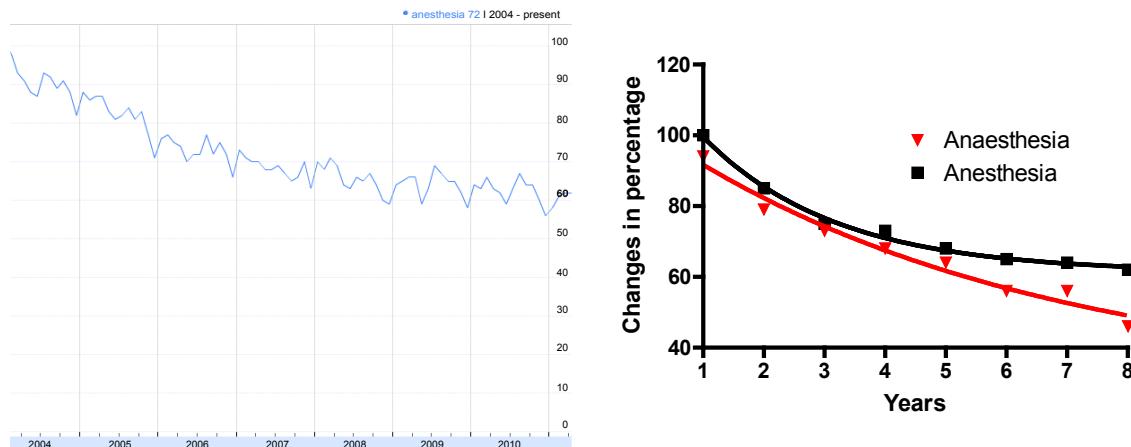


Figure 1: Proportional measures of frequency that the search term “anesthesia” was entered by users at the main google search page (www.google.com) over the time period 2004 – 2010 (X axis). Each measured time point is expressed as a normalized percentage of the search frequency (Y axis). Note the steady decrease in both of these searches over time. Left panel is the screen shot from the authors’ computer using Google Insights for Search (<http://www.google.com/insights/search/#>; accessed: April 30, 2011). Right panel is the graph generated using the numeric data obtained from the Google server. Y axis represents the normalized percentage of the search frequency in January of each year, and X axis represent each year starting year 1 for 2004. A clear exponential decrease is demonstrated for both “anesthesia” and “anaesthesia” as keywords.

Interest Over Time for ‘anesthesia saftey’

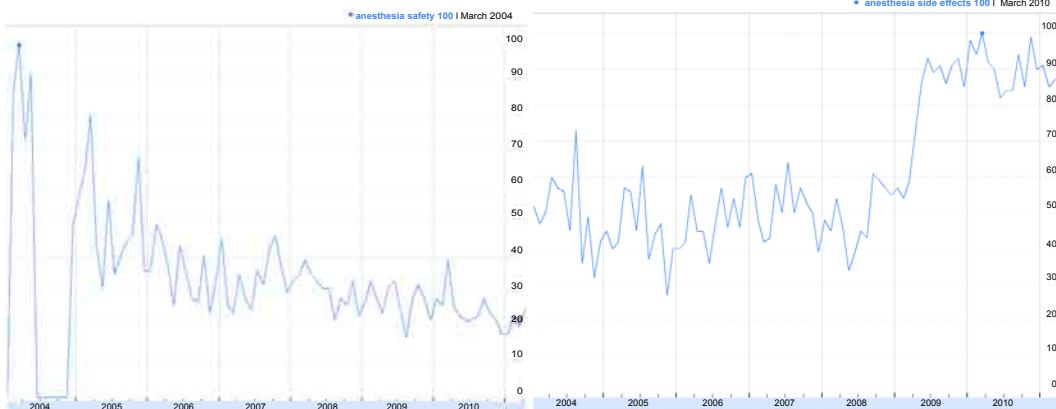


Figure 2: Proportional measures of the frequency that the phrase “anesthesia safety” (left panel) and “anesthesia side effects” (right panel) were searched from the main google search page (www.google.com) over the time period 2004 – 2010 (x-axis). Each measured time point is expressed as a normalized percentage of the maximum search frequency (y-axis). In contrast to the observed decrease in web interest in the phrase anesthesia safety (left panel) the search phrase anesthesia side effects is trending up over the same time period (right panel). Results are screen shots from the authors’ computer using Google Insights for Search (<http://www.google.com/insights/search/#>; accessed: April 30, 2011).

that for “anesthesia” (Figure 3). The searches for “surgeon” as a keyword remained constant, but it is at a higher level than that for “anesthesiologist” despite an increase in recent years (Figure 4).

Pre anesthesia vs. before anesthesia: Medical terminology is searched less frequently than their colloquial equivalents. For example, “before anesthesia” is searched more frequently than “preanesthesia”, while the searches for “before anesthesia” is steadily increasing (Figure 5).

Pain: Using “pain” as a keyword is steadily increasing over the years (Figure 6). The searches for specific pain-related terms are more prevalent than that of “anesthesia and side effects”. The top concern is “the pain after surgery” (Figure 7).

The trend of the availability of peer reviewed literatures

The total number of published peer reviewed articles from 2004 to 2010 has gradually increased 21% for “anesthesia” ($p = 0.0047$; Table 1), 50% for “anesthesia and outcome” ($p=0.0005$; Table 1) and 48% for “anesthesia and safety” ($p=0.0013$; Table 1). To reflect the proportional trend of manuscripts related to side effects, complications, safety and outcome out of all the manuscripts for anesthesia each year, we normalized the numbers based on total number manuscripts related to anesthesia and presented in Figure 8. It is clear that the proportion of manuscripts increased from 2004 to 2010 for both “anesthesia and safety” ($p=0.0137$; Table 1) and “anesthesia and outcome” ($p=0.0173$; Table 1). There is no significant change for the proportions of the

manuscripts if the key words of “anesthesia and side effects” ($P=0.444$; Table 1) or “anesthesia and complication” ($p=0.8165$; Table 1) are used. The total number of manuscripts related to preoperative evaluation is 1572 in 2004 and 2319 in 2010 (50% increase). The total number of manuscripts related to pain and outcome is 4,782 in 2004 and 8,421

in 2010 (83% increase); and the total number of manuscripts related to surgery and outcome is 24291 in 2004 and 41279 in 2010 (70% increase, data accessed in September 25, 2011). The result obtained from Medline is similar to that from PubMed as indicated in Figure 9 for “anesthesia and outcome”.

The comparison of the availability of posting (number of hits) in different search engines

Table 2 describes the total number of “hits” for several keywords thought to be important to anesthesiology (data accessed in January 4th, 2012). The order of keywords and the use of plural nouns had a small effect on the number of hits. While different search engines provide different total number of hits, the ratios of the hits indicate a comparable or similar trend among different search engines.

The economics related to advertisement for anesthesia, surgery and pain

“Pain” as a keyword is searched more frequently than “surgery” and “anesthesia” (Table 3). The estimated daily cost for online advertising related to potential customer searches for “surgery” ranked first, higher than both “pain” and “anesthesia”. The estimated daily spending for advertisement within an anesthesia related website is 28 fold less than that for pain and 33 fold less than that for surgery because the lower monthly searches on anesthesia despite the average cost per click for anesthesia is higher than pain and only half the price of surgery (Table 3).

Discussion

The use of Google Insights for Search has illustrated that internet searching on the general term “anesthesia” or “anaesthesia” is decreasing. The estimated daily cost/spending for advertisement in anesthesia related website is around 30 fold lower than that for pain and surgery. However, Google searches for “anesthesia side effects” are

Interest Over Time



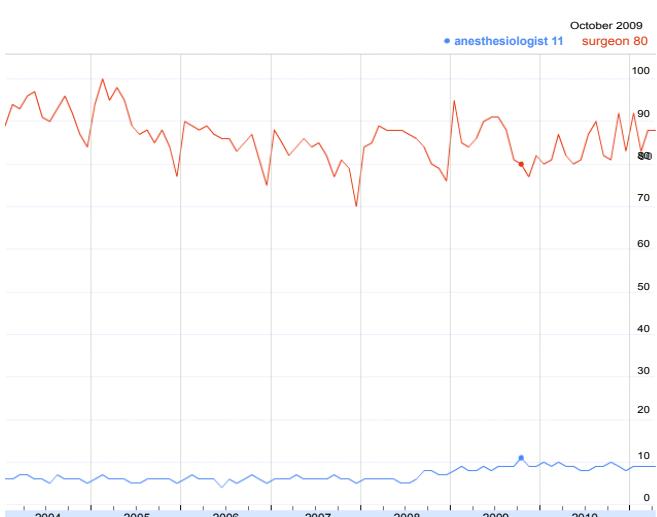
Figure 3: Proportional measures of frequency of entries of the search terms “anesthesia” compared to “surgery” by online users at the main google search page (www.google.com) over the time period 2004 – 2010 (x-axis). Each measured time point is expressed as a normalized percentage of the maximum search frequency for all phrases. The term “surgery” has consistently been searched with greater frequency than anesthesia. Results are screen shots from the authors’ computer using Google Insights for Search (<http://www.google.com/insights/search/#>; accessed April 30, 2011).

Interest Over Time for ‘anesthesiologist’



Figure 4: A. Proportional measures of frequency of entries of the search terms “anesthesiologist” compared to “surgeon” by online users at the main google search page (www.google.com) over the time period 2004 – 2010 (x-axis). Each measured time point is expressed as a normalized percentage of the maximum search frequency for all phrases. The term “surgeon” has consistently been searched with greater frequency; although interest in the term “anesthesiologist” has seen some increase since 2009. Panel B is an expansion of the data for only the search term “anesthesiologist” normalized to its maximum frequency. Results are screen shots from the authors’ computer using Google Insights for Search (<http://www.google.com/insights/search/#>; accessed: April 30, 2011).

Interest Over Time



Interest Over Time

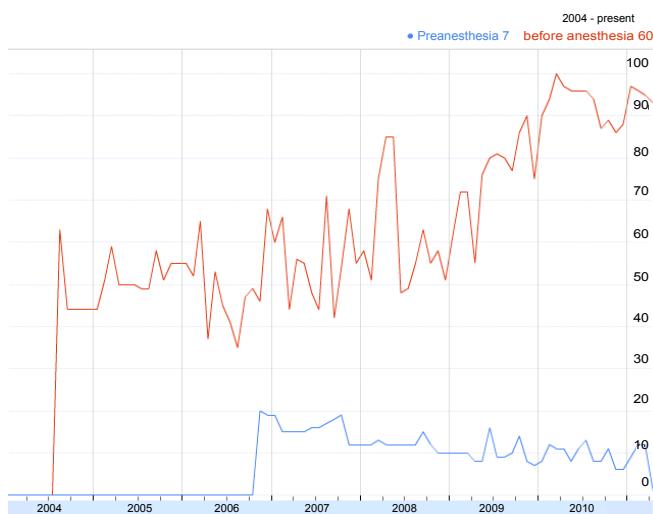


Figure 5: Proportional measures of frequency of the search term “preanesthesia” compared to the search phrase “before anesthesia” by online users at the main google search page (www.google.com) over the time period 2004 – 2010 (x-axis). Each measured time point is expressed as a normalized percentage of the maximum search frequency for all phrases. Google users tend to use the more conversational phrase “before anesthesia” rather than a more common hospital term “preanesthesia”. Results are screen shots from the authors’ computer using Google Insights for Search (<http://www.google.com/insights/search/#>; accessed: April 30, 2011).

Interest Over Time

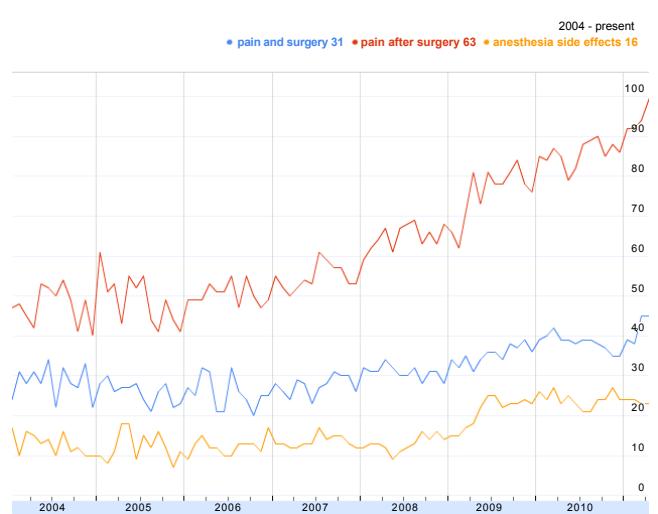


Figure 7: Proportional measures of frequency that the search phrases “pain and surgery”, “pain after surgery”, and “anesthesia side effects” were entered by users at the main google search page (www.google.com) over the time period 2004 – 2010 (x-axis). Each measured time point is expressed as a normalized percentage of the maximum search frequency for all phrases: “pain after surgery”. Web interest in this phrase has steadily increased since 2004. Results are screen shots from the authors’ computer using Google Insights for Search (<http://www.google.com/insights/search/#>; accessed: April 30, 2011).

Interest Over Time for 'pain'



Figure 6: Proportional measure of frequency for the search term “pain” by online users at the main google search page (www.google.com) over the time period 2004 – 2010 (x-axis). Each measured time point is expressed as a normalized percentage of the maximum search frequency. Results are screen shots from the authors’ computer using Google Insights for Search (<http://www.google.com/insights/search/#>; accessed: April 30, 2011).

trending up despite the fact that the safety in providing anesthesia care has improved over time [3-5]. The general concern for pain appears to be on the rise, especially pain after surgery. Similarly, there appears to be growing general interest in information related to “before anesthesia”.

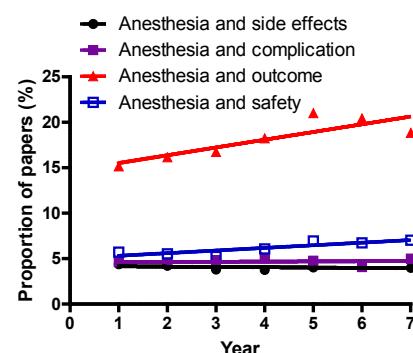


Figure 8: Proportions of peer reviewed papers on “anesthesia and side effects” (●), “anesthesia and complication” (■), “anesthesia and outcome” (▲), and “anesthesia and safety” (□), relative to papers published on anesthesia each year. Year 1 represents for 2004. Gradual significant increase of proportions of peer reviewed manuscripts on “anesthesia and outcome” ($R^2=0.71$, $P=0.0005$) and “anesthesia and safety” ($R^2=0.73$, $P=0.00137$) is demonstrated.

The total number of peer reviewed article related to anesthesia increased 20% from 2004 to 2010, among which manuscripts related to outcome, safety and preoperative evaluation increased 50%, 48% and 50% respectively. A similar trend is observed for pain, surgery and its related outcome. However, the total numbers of manuscripts are substantially more than that related to anesthesia.

Why should we care?

Industries change over time and it is vital for them to anticipate future trends and formulate effective strategies to adapt to these new changes. This certainly applies to the medical profession but more so to the field of anesthesiology given the expanding role of the practitioners

Table 1: Total number of peer reviewed manuscripts cited in PubMed from 2004 to 2010 related to anesthesia.

Year	Anesth	Anesth and side effects	Anesth and complication	Anesth and outcome	Anesth and safety
2010	8535	341	428	1609	600
2009	8209	343	334	1677	553
2008	7519	303	359	1579	523
2007	7544	284	380	1376	458
2006	7530	287	362	1260	395
2005	7459	314	330	1205	412
2004	7079	310	326	1073	405
% of Change	21	10	31	50	48

Anesth: anesthesia; % of change represents the percentage of changes from 2004 to 2010; Data accessed on Aug 14, 2011

Table 2: Approximate number of “hits” or web resources available as of January 4, 2012 for anesthesiology and perioperative keyword terms into common search engines.

	Google	Yahoo	Bing	PubMed	WebMD
anesthesia	38,200,000	31,700,000	33,300,000	254,854	907
surgery	99,800,000	332,000,000	316,000,000	3,109,086	8,520
surgery/anesthesia	2.6	10.5	9.5	12.2	9.4
pain	168,000,000	772,000,000	759,000,000	483,137	10,000
pain/anesthesia	4.4	24.4	22.8	1.9	11.0
anesthesiologist	1,290,000	5,980,000	6150000	3379	135
surgeon	114,000,000	132,000,000	133,000,000	54,132	2718
surgeon/anesthesiologist	88.4	22.1	21.6	16.0	20.1
preoperative	8060000	3,460,000	3,410,000	165,311	170
postoperative	36,400,000	6,700,000	6,630,000	515,253	353
postoperative/preoperative	4.5	1.9	1.9	3.1	2.1
before (and) anesthesia	25,200,000	20,800,000	21,700,000	254,854	530
before anesthesia/preoperative	3.1	6.0	6.4	1.5	3.1

Data accessed from January 4th, 2012

Table 3: Google AdWords results for the search terms “Anesthesia”, “Pain”, and “Surgery”.

Keyword	Global Monthly Searches	USA Monthly Searches	Estimated Avg. CPC	Estimated Ad Position	Estimated Daily Clicks	Estimated Daily Cost
Anesthesia	823,000	550,000	\$1.34	1.59	91	\$125.53
Pain	20,400,000	11,100000	\$0.60	1.52	5,753	\$3,511.60
Surgery	13,600,000	7,480,000	\$2.23	1.64	1,832	\$4,182.50

Estimated Avg. CPC: Average Cost-per-click; Estimated Ad position: the Ad position in all the web pages (https://adwords.google.com/o/Targeting/Explorer?_u=1000000000&_c=1000000000&ideaRequestType=KEYWORD_IDEAS#search.none, web accessed: April 30, 2011).

of this specialty in recent years. Though forecasting changes in an accurate manner can be problematic, evaluating trends in the recent past can, however, provide insightful information.

Surveys have historically served as the classic tool to investigate the interests, concerns and even subtle psychological changes over a certain issue of the public. However, compared to internet search engines, the use of surveys presents the obvious limitation of scale- it is very difficult (almost impossible) to reach the scale of data available in the query data bank representing a wide time frame across the world where English is used for keyword searching. Although the use of public search engines has been criticized for the accuracy of the data made available, [15] the results of the query data should be reliable and analysis of the query data has been successfully utilized in medicine to detect influenza epidemics [11] and to provide real time data on kidney stone disease in the United States [13,14].

The major focus of this investigation is on the trend of query data and the availability of data. While we provided the total numbers of hits in Google, Yahoo, Bing and PubMed and WebMD, our discussion is limited on the absolute number related to these searching results since yearly trend cannot be provided by these search engines. The differences in the total number of hits (postings) among these search

engines may be related to the goal of the service, the available data bank and the search algorithm. The PubMed and WebMD search engine, which only link to peer-reviewed literature or highly selected literature, has considerably less hits than the more general search engine. Despite these differences, it is interesting to note that the ratios of total number of hits are consistently indicating the same or similar trend among all the search engines.

The availability of literature available in PubMed or Medline reflects the trend of our research. The analysis of these data indicates the trend of interests of our physicians and scientists and whether our scientific research is consistent with public interests. The results of the trend from Medline should be comparable with that obtained from PubMed as indicated in Figure 9.

General interests regarding anesthesia

While the frequency of “surgery” as a keyword has remained steady, the search for “anesthesia” decreased exponentially. This finding by itself does not necessarily imply a decrease of public awareness or interest but this conclusion can be reached when the lower average cost for advertisement related to anesthesia compared to that for surgery or pain is taken into consideration. The low advertisement cost represents

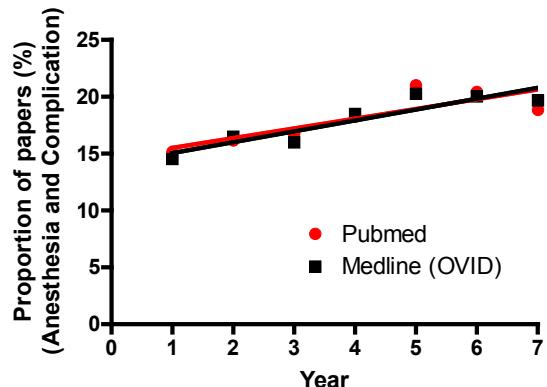


Figure 9: Proportions of peer reviewed papers on “anesthesia and outcome” in Medline (■) and PubMed (●) relative to papers published on anesthesia each year. Year 1 represents for 2004. Almost identical pattern of changes are noted.

a decreased investment by businesses, which is a manifestation of less entry of those keywords which we take to mean an overall lower general interest.

One of the potential causes for the decreasing searches for anesthesia as a keyword may be related to improvements in the safe delivery of anesthesia. Morbidity and mortality rates related to anesthesia have decreased dramatically in the last decade due in part to the advancement of anesthesiology and modern monitoring technology [4,5]. Given that anesthesia remains among the top leaders in patient safety and serves as a model for other specialties, it is concerning that the search for “anesthesia and side effects” is increasing. While we are celebrating newer anesthetics with fewer side effects and dramatically decreased morbidity and mortality related to anesthesia, the general concerns are focused on anesthetic side effects and potential adverse outcomes related to anesthesia. Perhaps this is because the incidence of minor events or complications during anesthesia remains high (18–22% of all cases) [5] It is possible that the general public uses side effects as a generic term for these situations. Because of this, efforts to improve public awareness about anesthesia and its role in patient outcome, especially during the perioperative and periprocedural periods, are needed.

The data clearly demonstrates that in general, colloquial terms are favored over technical terminology when searching for health-related information, as evidenced by comparison of “preanesthesia” and “before anesthesia” in the query data and number of available posting. While searches for “preanesthesia” are relatively stable and may even be trending down, searches for “before anesthesia” are higher than that of “preanesthesia” and likely trending up. Anesthesiologists should take advantage of this obvious rise in concern in preanesthesia and utilize the preanesthesia/preoperative evaluation and preparation to deliver appropriate messages regarding the advances in the field of anesthesiology. However, this should not occur at the expense of a thorough preoperative evaluation, as poor preoperative patient evaluations can contribute to complications and worse outcomes [4]. It is apparent that information available on the internet for preoperative concerns is much less than of postoperative concerns as indicated by the total number of hits across all search engines.

Searches for “surgery” or “surgeon” as key words occur much more frequently than that of “anesthesia” or “anesthesiologist.” This is consistent with the ratio of total number of available postings related

to these key words as indicated in Table 2. This might reflect the public’s perspective on the relative importance of the two specialties, but it may also be attributed to the limited time of interaction between the anesthesiologist and the conscious patient and family members. Anesthesiologists may suffer from not being associated with cures to any particular disease; however, health benefits from anesthesia services are difficult to measure and separate from the outcome of a procedure or surgery.

Although the searches for “anesthesia” as a keyword are steadily decreasing over the years, the searches for “anesthesiologist” as a keyword are increasing post-2008. It is unclear whether the increase is related to the increasing concern for anesthesia and side effects or if it is purely a mild increase in interest regarding securing a job as an anesthesiologist.

Pain: An area for greater impact?

Searches for “pain,” “pain and surgery,” and “pain after surgery” as keywords are increasing. The rate of increase is highest for “pain after surgery,” more so than “pain and surgery” or “anesthesia and side effects”. This suggests that pain, especially post-operative pain, is a major concern from the perspective of the patients and their family members. Because of the emotions associated with the sensation of pain, there is a great opportunity to steer these patient interactions into positive experiences that can potentially be remembered by patients and communicated amongst family members.

Globally, searches involving “pain” as a keyword are 25 times more common in comparison to searches using “anesthesia” as a keyword. Likewise, pain is more likely to be searched for than “surgery”. The estimated advertising costs (per click) are less for pain than for either anesthesia. However, its related daily cost is much higher than that for anesthesia because the total number of clicks related to pain is higher than that for anesthesia and surgery as indicated in Table 3.

The anesthesiologist’s expertise in analgesia should be parlayed into distributing reliable information regarding the role of anesthesiologists in healthcare (e.g., the ASA lifeline campaign: Anesthesiologists are the lifeline of modern medicine; <http://www.lifelinecampaign.com/>). Anesthesiologists should continue to emphasize their role in pain related issues during the peri-operative period and expand their role in the post-operative period. Better pain control after surgery is related to improved patient satisfaction. It has been demonstrated that the lower postoperative pain ratings were the best predictors of satisfaction and helpfulness of treatment [16].

More effort on anesthesia and outcome study needed

While the total number of peer reviewed articles related to anesthesia and the proportion of articles related to outcome are increasing, indicating that researchers are addressing the concerns, the total numbers of peer-reviewed articles related to anesthesia and outcome or safety are relatively small as compared to that of surgery and outcome (1,069 for anesthesia vs 41,279 for surgery in 2010). Anesthesiologists have very limited exposure and a short term relationship with a conscious patient and family members. The work related to anesthesia is mostly within the operating theater, thus, it has limited visibility to the public. However, more high quality research work on anesthesia and outcome should increase the visibility and improve satisfaction of patients after anesthesia.

Limitations

While the findings of this study are consistent with the apparent

general impressions, unintentional bias may exist because of the indirect data measured. For example, multiple other search engines exist in addition to the search engines investigated in this study including Safari by Apple, Digg (<http://digg.com/>) and others. The existence of these other search engines may confound the overall query data. The pattern of searches or the default searching engine for some people may have changed over the time frame investigated. Thus, the overall searching trend of any specific topic reflected by one search engine might be affected. However, this pattern should be similar for all of the searches performed in this investigation. Google is still the dominant search engine in the market (between 67–72% of the market since 2007, data from press releases at www.hitwise.com, accessed June 17, 2011). It should be noted that both the medical and the non-medical (lay) public alike can search using online search engines (i.e., Google or PubMed) as there are no restrictions regarding who has the ability to enter keywords on the website. However, only PubMed restricts its links to contain only peer-reviewed information in the form of published manuscripts of clinical and laboratory significance.

Another potential language factor affecting the results is the variability in terms or keywords in different languages for similar or identical topic of interest (spelling anesthesia an alternate way, e.g. anaesthesia). This may confound the overall number and trend of searching. Interestingly, the keyword of “anesthesia” and “anaesthesia” indicated a very similar trend. However, we did not use the combination of anaesthesia with other keywords, thus, our results do not reflect the interest in other regions that use the alternative spelling (i.e., United Kingdom or Australia) or on web interest in perioperative keywords from non-English-speaking regions of the world.

In conclusion, general interest for anesthesia appears to be decreasing, while there is an increasing concern for the side effects of anesthesia. Based upon the analysis, pain, especially pain after surgery, preanesthesia evaluation, anesthesia and outcome and side effects of anesthesia are the critical areas that anesthesiologists should focus on to address the increasing concerns of the patients and their family members or increase the visibility of the specialty. Anesthesiology organizations could capitalize on these trends to increase national visibility and raise awareness regarding the role of the specialty.

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