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Original Research

Evaluating Public and Scientific Interest in Point-of-Care Ultrasound: A Google Trends Analysis from 2007 to 2021

Sanjit Menon, B.S.[1], Sridhar Musuku, M.D.[2]

[1] Albany Medical College, Albany Medical Center Hospital, [2] Department of Anesthesiology, Albany Medical Center Hospital

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Objective

As researchers continue to explore point-of-care ultrasound (POCUS) in various clinical settings, it becomes increasingly imperative to anticipate patients' interests and respond effectively to advancements in imaging using POCUS-related search trend analyses. The purpose of this study was to compare the public interest in POCUS to the published literature on this topic from 2007 to 2021 using Google Trends (GT).

Methods

Google Trends (GT) data were obtained from 2015 to 2021 for the following terms: point-of-care ultrasound, portable ultrasound, transthoracic echocardiography, transesophageal echocardiography, regional ultrasound, FAST ultrasound, focused ultrasound, trauma ultrasound, rapid ultrasound. Annual publication data related to POCUS was collected from PubMed by filtering for the same terms and duration. Univariate linear regression was performed to determine whether there was a significant correlation between GT search volumes and PubMed publication data. Potential temporal trends were analyzed by calculating the deviation in interest for each month against the respective mean interest for each search term that returned a statistically significant positive correlation to PubMed publication data.

Results

POCUS-related publication frequency (R^2 = 0.89, P = 0.001) on PubMed demonstrated a significant linear relationship with time. When assessing trends in public interest over time, the following search terms demonstrated significant associations: point-of-care ultrasound (R^2 = 0.76, P = 0.011), portable ultrasound (R^2 = 0.68, P = 0.022), regional ultrasound (R^2 = 0.67, P = 0.024), and FAST ultrasound (R^2 = 0.67, P = 0.025). Univariate linear regression revealed statistically significant positive correlations between GT search volume trends and POCUS-related publication frequency on PubMed for point-of-care ultrasound (R^2 = 0.67, P = 0.024) and regional ultrasound (R^2 = 0.80, P = 0.006).

Conclusions

This study highlights the significant growth in public and scientific interest in point-of-care ultrasound over time. These findings aim to prepare clinicians for a rise in patient encounters during which POCUS may be a point of discussion, education, or concern.

INTRODUCTION

Point-of-care ultrasound (POCUS) is a medical imaging technique that utilizes ultrasound at the patient's bedside to provide real-time diagnostic information and aid in clinical decision-making.[1] It is a versatile tool that can be used to guide procedures, visualize anatomical structures, assess organ function, and detect abnormalities or pathologies.[2] POCUS is increasingly being used in various medical specialties, including general practice, anesthesiology, surgery, and emergency medicine.[3-5]

The use of this technology has been the subject of numerous research studies for the past two decades. When examining patients with suspected hemidiaphragmatic movement abnormalities, Houston et al.[6] determined that POCUS has superior diagnostic sensitivity and specificity compared to other diagnostic modalities, while also limiting the expenses and potential radiation-related side effects of non-ultrasound imaging. In surgical settings, POCUS was found to be particularly useful in the diagnosis and management of abdominal injuries, shock, respiratory insufficiency, and cardiac arrest.[7] When investigating its

use in the emergency department, Hilsden et al.[8] highlighted the benefits of POCUS in evaluating patients with biliary conditions, such as gallstones, for possible surgical intervention. As research in this field expands, point-of-care ultrasound is continually introduced to patients in various clinical settings.[9,10] Recent advancements by biotechnology companies like Butterfly iQ have even allowed individuals to purchase their own handheld ultrasound device with smartphone compatibility.[11]

With access to the Internet and resources such as Google, patients can educate themselves about medical conditions, interventions, and technologies like POCUS faster than ever before.[12] Google Trends (GT) is an open-source, online tool that tracks how frequently terms are searched on the website over a given period. Few studies involving GT have examined trends in medical imaging.[13-15] Adelhoefer et al.[13] conducted a Google Trends analysis that determined a decrease in public interest across all imaging modalities during the COVID-19 pandemic. GT studies have also evidenced significant trends in cancer screening and interventional oncology, indicating its ability to identify developing interests in this field among the general patient population.[14,15]

The purpose of this study was to evaluate trends in public interest and scientific literature from 2015 to 2021 as it pertains to point-of-care ultrasound. The hypothesis is that growth in public interest and scientific literature will be significantly correlated over time. This research was conducted to benefit clinicians in identifying and addressing the needs of the patient population as this technology becomes increasingly accessible.

METHODS

SEARCH TERMS

Google Trends is an online resource that measures the popularity of searchable terms on the Internet.[16] Search terms were generated using the "related queries" feature of GT, as well as researcher consensus. When a search is performed, Google Trends, generates pertinent data and graphs if the search terms meet a certain threshold of volume, a methodology that has been described in existing literature.[17-21] In the present study, "search terms" were included, as opposed to "search topics". Data was collected for the following terms: point-of-care ultrasound, portable ultrasound, transthoracic echocardiography, transesophageal echocardiography, regional ultrasound, FAST ultrasound, focused ultrasound, trauma ultrasound, rapid ultrasound. Institutional Review Board (IRB) approval was not necessary since this data was publicly available.

DATA COLLECTION

Normalized on a 0 (minimal popularity) to 100 (maximal popularity) scale, GT data are standardized to a ratio of the number of searches for each search term to the total number of searches within a specific geographic region and time frame.[16] The listed terms were also queried in an advanced PubMed search to obtain publication frequency from the same time frame. Publication frequency was graphed by year to determine a linear trend (Figure 1).

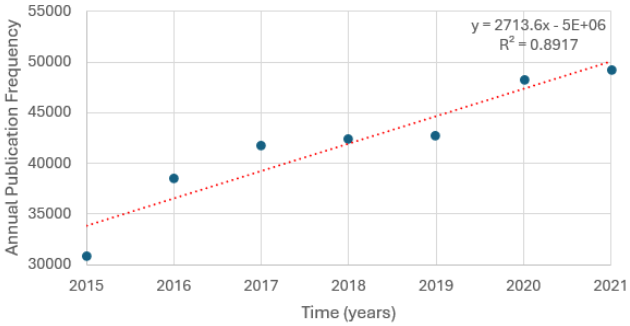

Figure 1. POCUS-Related Publication Frequency Over Time

STATISTICAL ANALYSIS

Linear regression analysis was performed to evaluate whether there was a significant association between GT search volumes and PubMed publication data. R-squared values and *P* values (alpha <0.05 for significance) were recorded. Potential temporal trends were analyzed by averaging the deviation in interest for each month against the respective annual mean interest for each search term that returned a statistically significant positive correlation to PubMed publication data. All statistical analyses and construction of figures and tables were performed in Microsoft Excel Version 15.21.1.

RESULTS

PUBLICATION FREQUENCY AND GOOGLE TRENDS DATA

POCUS-related publication frequency (R^2=0.89, P = 0.001) on PubMed from 2015 to 2021 demonstrated a significant linear relationship with time. The number of POCUS-related publications peaked in 2021 at 49,236 (Figure 1).

When assessing trends in public interest over time, the following search terms demonstrated significant linear relationships: point-of-care ultrasound (R^2=0.76, P = 0.011), portable ultrasound (R^2=0.68, P = 0.022), regional ultrasound (R^2=0.67, P = 0.024), and FAST ultrasound (R^2=0.67, P = 0.025). Transthoracic echocardiography, transesophageal echocardiography, focused ultrasound, trauma ultrasound, and rapid ultrasound did not demonstrate significant relationships with time (Table 1).

Linear regression analysis revealed statistically significant positive correlations between GT search volume trends and POCUS-related publication frequency on PubMed for two terms: point-of-care ultrasound (R^2=0.67, P = 0.024) and regional ultrasound (R^2=0.80, P = 0.006). Although they showed significant linear growth over time, search volume trends for portable ultrasound and FAST ultrasound did not exhibit significant association with POCUS-related publication frequency (Table 2).

Table 1. Search Volumes Over Time

Terms	R-squared	P Value
point-of-care ultrasound	0.758	**0.011**
portable ultrasound	0.683	**0.022**
transthoracic ultrasound	0.201	0.313
transesophageal ultrasound	0.395	0.130
regional ultrasound	0.672	**0.024**
FAST ultrasound	0.665	**0.025**
focused ultrasound	0.093	0.505
trauma ultrasound	0.220	0.288
rapid ultrasound	0.458	0.095

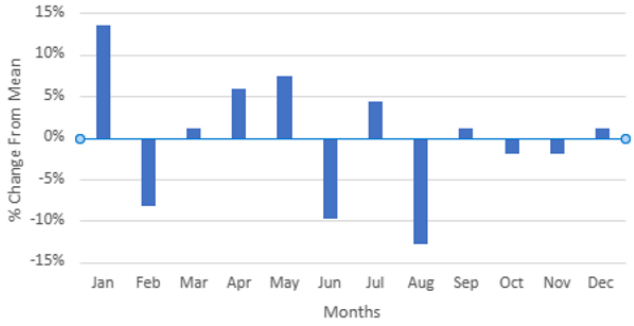

Figure 2. Temporal Trends for Search Term "point-of-care ultrasound"

Table 2. Linear Regression Between Search Volume Trends and Publication Frequency

Terms	R-squared	P Value
point-of-care ultrasound	0.673	**0.024**
portable ultrasound	0.527	0.065
regional ultrasound	0.804	**0.006**
FAST ultrasound	0.538	0.061

TEMPORAL TRENDS

Temporal trends were analyzed by measuring the monthly deviation from the mean search volume for each significantly correlated search term. According to our findings, peak interest in point-of-care ultrasound and regional ultrasound occurred in January (+14%) and March (+11%), respectively. The greatest decline in interest for point-of-care ultrasound occurred in August (-13%). Both August (-11%) and September (-11%) data exhibited the least interest in regional ultrasound (Figure 2, Figure 3).

DISCUSSION

Point-of-care ultrasound is a rapidly growing modality that has become standard of care in various fields including general practice, anesthesiology, surgery, and emergency medicine.[22-24] This rise in popularity can be attributed to a few different factors. Firstly, advancements in technology have made ultrasound devices more accessible and user-friendly, allowing for rapid and convenient imaging at the bedside.[22] Additionally, the speed and efficiency of POCUS make it a valuable tool in emergency situations, where timely diagnosis and treatment are crucial.[23] The portability of POCUS devices also allows for its use in various healthcare settings, including primary care and prehospital care.[22,24] Despite its growth, there are still areas that require further research and validation. For example, there is need for more evidence to support the use of POCUS in specific clinical scenarios, such as its ability to accurately reflect histological disease.[25] Additionally, reimbursement issues may pose a barrier to the widespread adoption of POCUS.[22]

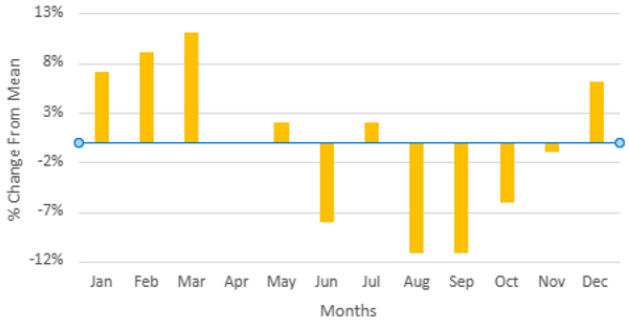

Figure 3. Temporal Trends for Search Term "regional ultrasound"

This study found that POCUS-related publication frequency demonstrated significant linear growth from 2015 to 2021, climbing from 30,750 publications in 2015 to its peak of 49,236 publications in 2021. These findings offer reinforcement of the assertion that point-of-care ultrasound is of rising interest in scientific literature. In that same period, GT search volumes in point-of-care ultrasound, portable ultrasound, regional ultrasound, and FAST ultrasound exhibited significant linear growth. These findings suggest that public interest in different types of point-of-care ultrasound increased with time, potentially due to the vast applications of this technology in clinical practice.[26,27] Recent advancements have even enabled everyday smartphone users to perform point-of-care ultrasound procedures by using handheld portable ultrasound systems such as Butterfly iQ and Kosmos.[28] These devices have improved access to POCUS technology at a fraction of the cost, especially in resource-limited settings.[29] This information prompted an investigation into whether there was a significant correlation between scientific literature and public interest in point-of-care-ultrasound.

Previous studies have used Google Trends, an online tool that monitors how frequently a term is searched on the Google search engine over a given period, to assess this type of correlation in different modalities.[18,20] Regression analysis determined that GT search volumes for point-of-care ultrasound and regional ultrasound demonstrated significant linear correlation with POCUS-related publication

frequency in the United States from 2015 to 2021. This significant relationship highlights that public interest in point-of-care ultrasound will continue to rise as more literature is published. As this growth continues, clinicians should be better prepared to answer questions regarding the details of the technology and procedure in different conditions. Hence, understanding trends in POCUS and how portable devices operate and compare against each other is vital to efficient clinical practice and patient education.[28]

Although they showed significant linear growth over time, search volume trends in portable ultrasound and FAST ultrasound did not exhibit significant relationships with POCUS-related publication frequency. This may be due to insufficient data or may suggest that research in point-of-care ultrasound has yet to impact patient interest in portable ultrasound and FAST ultrasound, specifically.

Google Trends has also been utilized in research as a means of assessing temporal trends.[30-33] This study found peaks of public interest in point-of-care ultrasound and regional ultrasound in January (+14%) and March (+11%), respectively. For point-of-care ultrasound, popularity was lowest in August (-13%). For regional ultrasound, declines in popularity were greatest in August (-11%) and September (-11%). According to our results, patient interest is relatively high in the beginning of the year and tapers off by the end. This temporal data can inform clinicians on when to expect a greater influx of questions or patient visits in which point-of-care ultrasound is discussed. More research could be done to determine the regional difference in public interest.

Google Trends has been a powerful tool in medical research given its ability to predict popular trends, from elective plastic surgery to public health crises.[34,35] Past GT analyses have shown a decline in public interest in diagnostic imaging coupled with delays and deferrals during the COVID-19 pandemic.[13] This allowed researchers to predict the high demand for medical care in the following months while building risk-stratification algorithms to allocate resources and avoid collapse of the healthcare system.[13] Similarly, we hoped to elucidate general and temporal trends in public and scientific interest to create a more informed and prepared community of physicians and patients.

LIMITATIONS

There are some limitations of this study which generally apply to Google Trends analyses. Google Trends lacks adequate data for certain search terms, posing a constraint when exploring commonly used keywords instead of technical terms. This limitation makes it challenging to adopt a formal method for excluding potentially associated search terms. Moreover, the study is confined to public interest within the United States, emphasizing the importance of future investigations into additional terms and regional trends to affirm the reliability of GT. Google Trends solely gauges the public utility of the Google search engine, omitting users of other search engines. Additionally, PubMed data may not encompass literature indexed by alternative publication services. Lastly, in terms of statistical analysis, R-squared values can be limited by their inability to account for overfitting.[36]

CONCLUSION

This study highlights the significant correlation between public interest in point-of-care ultrasound and POCUS-related publication frequency from 2015 to 2021. We aim to aid clinicians in understanding the potential curiosities and concerns of their patients when considering point-of-care ultrasound. Temporal trends of public interest in POCUS indicate a relative rise in popularity in the beginning of the year that tapers off by the end of the year. This information can better prepare clinicians for when to expect more POCUS-related questions, leading to a more productive and cohesive clinical encounter. Google Trends is a powerful tool that can be utilized in additional research to further understand public interest in ultrasound technology.

List of Abbreviations: POCUS, point-of-care ultrasound; GT, Google Trends

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