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Scholarly activity points: a new tool to evaluate resident scholarly productivity[†]

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Editor's key points

- Scholarly activities of anaesthesia trainees/residents include research and presentations at scientific meetings.
- Scholarly productivity can be rated according to complexity, importance, and degree of trainee involvement.
- This study outlines a new scoring system that quantifies such scholarly productivity.
- The scoring system can be used to assist in the evaluation of anaesthesia trainees and their training programmes.

Background. Scholarly activity is an important aspect of a resident's educational experience; however, evaluation methods have remained underdeveloped despite the increased focus over the last decade. A new scoring system is proposed as a comprehensive evaluation tool.

Methods. In this scoring system, each scholarly activity (i.e. abstracts, manuscripts, book chapters, research protocols, and research grants) are converted into a numerical score, Scholarly Activity Points (SAPs), which reflects the complexity of the project and the degree of resident's involvement. First, a relative weight value is given to each scholarly category based on its complexity (i.e. 50 points to an abstract, 150 to a manuscript). Then SAPs are calculated with modifiers specific to each scholarly activity (i.e. for an abstract, meeting venue, repeated presentation, authorship, abstract category, and awards). To demonstrate how the system works, a list of scholarly activities by anaesthesia residents graduating from a university programme between 2003 and 2010 was obtained. SAP scores of graduating classes were analysed.

Results. During the 2003–2010 academic years, a total of 106 residents (the mean of 13 per class, ranging from 9 to 19) graduated from the full 3 yr residency programme. The SAP system allowed statistical comparison among the graduated classes of overall scholarly productivity; significant increases were noted in the average SAPs per resident among the classes of 2009 {154 (204), [mean (sD)]} and 2010 [524 (471)] compared with those by the classes of 2003–2006 [90 (188), 45 (73), 126 (349), 83 (205), respectively].

Conclusions. A new scoring system enabled a comprehensive statistical evaluation of residents' scholarly productivity.

Keywords: academic; anaesthesiology; education; evaluation; portfolio; scholarly activity

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Facilitating residents' engagement in scholarly activity is one of the indispensable aspects of any medical specialty's future growth.[1][2] Over the last decade, the anaesthesiology Residency Review Committee (RRC) in the USA, along with the CanMEDS framework and leaders in the field, have stressed the importance of resident scholarly activity as a means to increase the overall educational experience and meet the core competencies of a residency programme.[3] Specific guidelines have been implemented to mandate completion of a scholarly activity project by the end of a resident's training [http://www.acgme.org/acWebsite/downloads/RRC_progReq/040_anesthesiology_07012008_u03102008.pdf (accessed April 28, 2012)]. Despite the increased focus and attention on resident scholarly productivity, evaluation methods of its quality have remained underdeveloped. A comprehensive and universal evaluation tool is needed to help residency programmes gauge residents' scholarly productivity.

Objective evaluation of residents' participation in scholarly activity is challenging. First, the definition of scholarly activity must be determined, taking into account Boyer's and Glassick's widely applied new concept of four scholarship areas (the scholarship of discovery, the scholarship of integration, the scholarship of application, and the scholarship of teaching).[4–6] Secondly, previous attempts to evaluate scholarly activity were mainly focused on faculty members, not trainees.[7][8] Direct application of the existing faculty scholarly activity evaluation method may not be feasible. Thirdly, even in

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evaluating the well-established scholarly activity category of peer-reviewed publications, researchers have discussed how to evaluate a published manuscript's quality using bibliometric analyses.[9–11]

We propose, here, a new scoring system, Scholarly Activity Points (SAPs), specifically designed to comprehensively evaluate residents' research activity. The efficacy of the SAP evaluation system was demonstrated using the scholarly activity data of anaesthesiology residents in an academic residency programme. The primary goal of this article is to stimulate discussion regarding resident scholarly activity assessment.

Methods

This study was approved by University of Pittsburgh School of Medicine Institutional Review Board (IRB) (IRB# PRO10120290).

The new evaluation system: scholarly activity points

SAPs are defined based on a merit matrix system detailed in Table 1. Two factors are proposed to generate SAPs for each scholarly activity: relative weight values and modifiers.

Relative weight values

Each scholarly activity category is awarded a relative value weight to yield a unified number of SAPs (Table 1). This allows further analysis of scholarly productivity, combining various scholarly activities together into total SAPs.

The relative weight value of each scholarly activity are set as follows: 50 points for an abstract, 150 for a manuscript, 50 for a book chapter, 100 for a grant submission, 75 for a research protocol submission, and 25 for other activities (a book review or a letter to the editor).

Modifiers

The basic idea of modifiers is that each scholarly activity is evaluated based on complexity, impact, and degree of resident involvement. Each scholarly activity is assigned specific modifiers. For abstract presentations, the following modifiers are employed: meeting venue, repeated presentation, authorship, abstract category, and award (Table 1). For example, when a resident presents an abstract at a national meeting ($\times 1.0$ by modifier 1.1) as the first presentation of the abstract ($\times 1.0$ by modifier 1.2) as the first author ($\times 1.0$ by modifier 2.0) in an original research category ($\times 1.0$ by modifier 3.0) and receives an award ($\times 1.5$ by modifier 4.0), the abstract is assigned the modified number of 1.5 ($= 1 \times 1.0 \times 1.0 \times 1.0 \times 1.0 \times 1.5$) for calculation of its SAPs, which becomes 75 (the maximum SAPs of abstract category). On the other hand, when a resident presents an abstract at a local meeting ($\times 0.5$ by modifier 1.1) as a repeated presentation ($\times 0.5$ by modifier 1.2) as a colleagues ($\times 0.5$ by modifier 2.0) in a case report category ($\times 0.5$ by modifier 3.0) in poster format without award ($\times 1.0$ by modifier 4.0), the abstract is assigned the modified number of 0.0625 ($= 1 \times 0.5 \times 0.5 \times 0.5 \times 0.5 \times 1.0$) for calculation of its SAPs, which becomes 3.125 (the minimum SAPs of abstract category). For a

Table 1 SAPs evaluation system. IACUC, Institutional Animal Care and Use Committee; IRB, Institutional Review Board

Abstract SAPs$=50\times$(modifier $1.1\times$modifier $1.2\times$modifier $2.0\times$modifier $3.0\times$modifier 4.0)

    Modifier 1.1. Meeting venue: *national or international ($\times 1.0$); local or regional ($\times 0.5$)*

    Modifier 1.2. Repeated presentation in the same venue level: *Yes ($\times 0.5$); No ($\times 1.0$)*

    Modifier 2.0. Authorship: *first author ($\times 1.0$); colleagues ($\times 0.5$)*

    Modifier 3.0. Category: *original research ($\times 1.0$); case report ($\times 0.5$)*

    Modifier 4.0. Award: *award or podium presentation ($\times 1.5$); poster without award ($\times 1.0$)*

Manuscript SAPs$=150\times$ (modifier $1.0\times$modifier $2.0\times$modifier $3.0\times$modifier 4.0)

    Modifier 1.0. Peer-reviewed publication: *Yes ($\times 1.0$); No ($\times 0.5$)*

    Modifier 2.0. Authorship: *first author ($\times 1.0$); colleagues ($\times 0.5$)*

    Modifier 3.0. Category: *original research ($\times 1.0$); review article ($\times 0.75$); case report ($\times 0.5$)*

    Modifier 4.0. IF: *IF>0.5, then($\times$IF); 0<IF$\leq$0.5 or no IF, then ($\times 0.5$)*

Book chapter SAPs$=50\times$ (modifier $1.0\times$modifier 2.0)

    Modifier 1.0. Length (pages at time of submission): *≥ 10 ($\times 1.0$); <10 ($\times 0.5$)*

    Modifier 2.0. Authorship: *first author ($\times 1.0$); colleagues ($\times 0.5$)*

Grant submission SAPs$=100\times$ (modifier $1.0\times$modifier $2.0\times$modifier $3.0\times$modifier 4.0)

    Modifier 1.0. Authorship: *principal investigator (PI) or co-PI ($\times 1.0$); co-investigator (0.5)*

    Modifier 2.0. Agency: *federal ($\times 2.0$); foundation grant ($\times 1.5$); Department Seed Grant ($\times 1.0$)*

    Modifier 3.0. Grant awarded: *Yes ($\times 1.5$); No ($\times 1.0$)*

    Modifier 4.0. Life of the grant: *($\times$Yr)*

Research protocol SAPs$=75\times$ (modifier $1.0\times$modifier $2.0\times$modifier 3.0)

    Modifier 1.0. Agency: *IACUC ($\times 1.0$); IRB full board ($\times 1.0$); IRB expedited ($\times 0.5$); IRB exempt ($\times 0.25$)*

    Modifier 2.0. Authorship: *PI or co-PI ($\times 1.0$); co-investigator ($\times 0.5$)*

Other (Book Review, Letter to the Editor) SAPs$=25\times$(modifier $1.0\times$modifier 2.0)

    Modifier 1.0. Peer-reviewed publication: *Yes ($\times 1.0$); No ($\times 0.5$)*

    Modifier 2.0. Authorship: *first author ($\times 1.0$); colleagues ($\times 0.5$)*

manuscript, the following modifiers are considered: peer review, authorship, manuscript category, and impact factor (IF) (Table 1). The IF of the journal is used as a surrogate maker of impact of the manuscript, because the follow-up period is limited to take the number of citations of the manuscript into account. The IF of each journal available at the time of publication of a given manuscript is used, which is verified using Journal Citation Reports® (ISI Web of Knowledge^{SM}, Thomson Reuters, New York, NY, USA—http://www.webofknowledge.com, subscription-based service). The minimum SAPs for a manuscript becomes 9.375 (the minimum modified number of 0.0625=non-peer reviewed, colleagues, case report, no IF) (Table 1).

Evaluation of the SAP system

In order to test usefulness of the new evaluation system, the SAP system was applied to the scholarly activity data of anaesthesiology residents who graduated from the Department of Anesthesiology, University of Pittsburgh School of Medicine programme, between 2003 and 2010. The class of 2003 was selected as a starting point attributable to the utilization of electronic record storage starting with this class, and the class of 2010 was the most current at the time of the initial analysis.

Scholarly record of anaesthesiology residents

All potential resident scholarly activities were recorded prospectively in the department's residency programme office as part of Accreditation Council for Graduate Medical Education (ACGME) required recording of resident activities. The list of the activities was based on self-reported information by residents, which had been verified at each semi-annual meeting between the resident and the residency director.

The list included peer-reviewed manuscripts (authors, title, and name of the journal, with or without a formal citation), manuscripts that were written but did not reach peer-reviewed publication, abstracts accepted and presented (authors, title, meeting, location, and data), book chapters published (authors, title, and book publication information), IRB or IACUC protocol approval of research studies (investigators, title, and date), submission of research grants (investigators, title, funding agency, funding result), and other factors (authorship in published books, letters to the editor, articles in non-peer-reviewed journals). Awards received for each activity were also recorded. Intra-departmental presentations (mandatory presentation during subspecialty rotations, *ad hoc* presentations at morbidity and mortality conferences and at grand rounds) and extra-departmental presentations (invited lectures) were also recorded. Participation in educational activities (as an instructor of medical student courses or a facilitator of medical student educational workshops) and leadership activities (such as a resident delegate for a medical society) were also recorded.

Scholarly activity: inclusion and exclusion criteria

In order to construct and test a new evaluation system to evaluate resident scholarly activity, the following scholarly activities were selected among the scholarly records recorded in the department and included in the analysis: abstract presentations at meetings (local, regional, state, national, and international), publications (case reports, review articles, and original articles), book chapters, institutional approval of research studies (both basic and clinical research), submitted research grants (departmental, professional society, and federal funding agencies; both awarded and not awarded), and other publications (authorship in published books, letters to the editor).

Of note, only scholarly activities based on the work performed during post-graduation year (PGY)1–PGY4 was included. Any research activity based on work performed before the commencement of PGY1 was excluded (i.e. publications based on the work done during medical school or PhD), even though these works were often published or accepted for publication during their residency. Residents' scholarly activities were monitored and included in the analysis up to 1 year after each resident's graduation to account for the possibility of time-lag in acceptance of manuscripts or abstracts submitted during the PGY4 year. Consequently, the study period for inclusion of each resident's scholarly activities spanned 5 yr. To verify the publication record of manuscripts, each resident's name and 'University of Pittsburgh School of Medicine' was searched for on the PubMed web site (http://www.ncbi.nlm.nih.gov/pubmed/).

The following activities were excluded from the scholarly activity evaluation system: research activities that did not result in an accepted abstract at a meeting, research manuscripts which were not accepted for publication, intra-departmental and extra-departmental presentations, or participation in educational and leadership activities. Intra-departmental and extra-departmental presentations were not included in this study as they were uniformly completed as required components of the resident's rotation. Unpublished abstracts and manuscripts, and educational and leadership activities, were not included in the study as these scholarly activities were not routinely recorded for all residents, and no clear objective evaluation system is available for a point system at this time.

Impact of modifiers in the SAP system

A sample resident population's (class of 2010) scholarly activity was evaluated using the SAP system modifiers (Table 1). The results were compared with a traditional evaluation system (simple number of each scholarly product). Changes in scores attributable to the modifiers were demonstrated in abstracts and manuscripts, respectively.

Impact of relative weight values in the SAP system

Scholarly activities of the classes of 2003–2010 were converted into SAPs. Average SAPs per resident per graduation class were calculated and compared to demonstrate feasibility of SAPs for statistical analysis.

Data description and statistical analysis

Data are reported as mean (1 SD) unless otherwise indicated. The comparison of average SAPs per resident per graduation year was performed using the Kruskal–Wallis test with the *post hoc* Dunn's multiple comparison test. The percentage of residents with zero SAPs between the classes of 2003–2004 and the classes of 2009–2010 was compared using Fisher's exact test.

A *P*-value of less than 0.05 was considered statistically significant. Statistical analysis was performed using GraphPad Prism 4 (GraphPad Software, Inc., La Jolla, CA, USA).

Results

Anaesthesiology residents

During the 2003–2010 academic years, a total of 106 residents (an average of 13 per class, ranging from nine to 19) participated in and graduated from the full 3 yr residency programme. The large variation in class size was attributable to the absorption of a smaller local residency programme and an expansion in the overall size of the residency programme during the 2003–2010 academic years. Those who had zero SAPs successfully fulfilled the ACGME scholarly activity requirement through an intra-departmental grand rounds presentation, which was not included in the SAP calculation.[12]

Evaluation of the SAP system

Modifiers

The sample resident population's (class of 2010) scholarly activity is listed with the modified abstract and manuscript numbers calculated (Tables 2 and 3).

The number of abstracts presented by each resident and modified with the SAP system is summarized in Figure 1. On average, the modified abstract numbers were 47.0 (25.2%) of that of the raw abstract numbers. The biggest reduction was found with Resident ID #2 who listed eight abstracts in scholarly activity records. The modified abstract number became 2.625 (32.8% of the raw number), due mainly to local meeting presentations, repeated presentations, and reductions in abstract points because of the case report category.

The number of manuscripts accepted for publication by each resident and modified by the SAP system is summarized in Figure 2. On average, the modified manuscript numbers were 156.6 (141.6%) of that of the raw manuscript numbers. The biggest increase was seen with Resident #1, who published two manuscripts with a modified number of 7.948 (397.4%) because of relatively large IFs. The biggest decrease was found with Resident #6, who published one paper with a modified number of 0.577 (57.7%), mainly attributable to secondary authorship and the case-report modifier within the manuscript category.

Relative weight values

A historical cohort of residents' scholarly activities is summarized in Table 4. A trend of increase was found in the mean number of abstracts presented at meetings; the class of 2003 presented 1.10 (1.50) abstracts per resident (11 abstracts by 10 residents), while the class of 2010 presented 3.92 (2.63) abstracts per resident (51 abstracts by 13 residents). The same trend was observed for peer-reviewed manuscripts accepted for publication; the class of 2003 authored 0.20 (0.40) published manuscripts per resident (2 manuscripts by 10 residents), while the class of 2010 authored 1.38 (1.19) published manuscripts (18 manuscripts by 13 residents).

All research activities were converted to SAPs (Table 4). Statistically significant increases were noted in the average SAPs per resident among the classes of 2009 and 2010 compared with those by the classes of 2003–2006. The percentage of residents with zero SAPs decreased significantly; more than half the residents graduated from the residency without any SAPs in the class of 2003 and the class of 2004 (52.4%: 11 of 21 residents); however, only one resident graduated without any SAPs in the class of 2009 and the class of 2010 (3.6%: 1 of 28 residents: $P < 0.0001$).

Discussion

A new scoring system to evaluate scholarly productivity by anaesthesiology residents was proposed. Modifiers were introduced to weigh scholarly products in categories reflecting complexity, significance, and degree of resident involvement. Relative weight values were proposed to merge productivity in different categories into one score. This SAP system allowed a comprehensive statistical evaluation of scholarly activities on a sample data of residents' scholarly activities.

The traditional approach of recording scholarly activities is to simply add up and list research activities.[12 13] Although this approach is fairly descriptive, it is difficult to compare overall scholarly activities among residents, graduating classes of residents, or residency programmes. The level of resident's contribution in a project (first author vs colleagues), impact, or significance of the scholarly product were disregarded at the time of reporting.[13 14]

This new scoring system re-evaluates a scholarly product based on the degree of involvement of the resident (authorship), complexity (category of presentation/manuscript), and impact (meeting venue or IF of the journal). Then, the system unifies various types of activities into a single score. Given the nature of the unified score, the analysis of the productivity trend in the programme's graduating classes and the evaluation of each individual resident's research activities can become comprehensive and technically straightforward.

Using a point system to evaluate resident academic productivity is not an entirely new concept. In 2009, a US Army family medicine residency programme showed that implementation of a point system can lead to increased research productivity.[15] Points were assigned for scholarly activities in various categories, such as research or teaching, covering all four of Boyer's types of scholarship (discovery, integration, application, and teaching) with more points given to discovery-related scholarly activities.[4 5] The exact point value (between 1 and 10 points) was ultimately left to the judgment of programme faculty based on number of residents involved in the project, resident effort, and complexity of the project.

Our method, however, takes the concept to a more comprehensive level, including weighting research activities based on a journal's IF and degree of authorship. The concept of assigning relative value weights to scholarly productivity has also been used in faculty incentive programmes

Table 2 The modified number of abstracts using the Scholarly Activity Point system (class of 2010). The grey area describes the total number of abstracts and the modified number of abstracts based on SAPs per resident. ID, identification number

Resident ID	Number of Abstracts	Modified number of Abstracts	Modified 1.1. Venue	Modified 1.2. Repeated	Modified 2.0. Authorship	Modified 3.0. Category	Modified 4.0. Award/podium
R1	1	0.125	0.5	0.5	1	0.5	1
	1	0.5	1	1	1	0.5	1
	1	0.375	0.5	1	1	0.5	1.5
	1	1	1	1	1	1	1
	1	1	1	1	1	1	1
	1	0.5	0.5	1	1	1	1
	1	0.25	0.5	0.5	1	1	1
	1	0.25	0.5	0.5	1	1	1
	1	1	1	1	1	1	1
Total	9	5					
R2	1	0.5	0.5	1	1	1	1
	1	0.25	0.5	0.5	1	1	1
	1	0.25	0.5	0.5	1	1	1
	1	0.5	1	1	1	0.5	1
	1	0.25	0.5	1	1	0.5	1
	1	0.125	0.5	0.5	1	0.5	1
	1	0.5	1	1	1	0.5	1
	1	0.25	1	0.5	1	0.5	1
Total	8	2.625					
R3	1	0.5	0.5	1	1	1	1
	1	0.25	0.5	0.5	1	1	1
	1	0.5	1	1	1	0.5	1
	1	0.5	1	1	1	0.5	1
	1	0.25	0.5	1	1	0.5	1
Total	5	2					
R4	1	0.75	0.5	1	1	1	1.5
	1	0.375	0.5	0.5	1	1	1.5
	1	0.375	0.5	0.5	1	1	1.5
	1	1	1	1	1	1	1
Total	4	2.5					
R5	1	0.25	0.5	1	1	0.5	1
	1	0.125	0.5	0.5	1	0.5	1
	1	0.75	0.5	1	1	1	1.5
	1	0.5	0.5	1	1	1	1
	1	0.5	1	0.5	1	1	1
Total	5	2.125					
R6	1	0.5	1	1	1	0.5	1
	1	0.375	0.5	1	1	0.5	1.5
	1	0.5	1	1	1	0.5	1
	1	0.25	0.5	1	1	0.5	1
Total	4	1.625					
R7	1	1	1	1	1	1	1
	1	0.5	0.5	1	1	1	1
	1	0.25	0.5	0.5	1	1	1
	1	0.5	0.5	1	1	1	1
Total	4	2.25					
R8	1	0.5	1	1	1	0.5	1
	1	0.5	0.5	1	1	1	1
	1	1	1	1	1	1	1
	1	0.25	0.5	0.5	1	1	1
Total	4	2.25					
R9	1	1	1	1	1	1	1
	1	1	1	1	1	1	1
	1	0.25	0.5	1	1	0.5	1
	1	1	1	1	1	1	1

Continued

Table 2 Continued

Resident ID	Number of Abstracts	Modified number of Abstracts	Modified 1.1. Venue	Modified 1.2. Repeated	Modified 2.0. Authorship	Modified 3.0. Category	Modified 4.0. Award/podium
Total	4	3.25					
R10	1	1	1	1	1	1	1
	1	0.375	0.5	1	1	0.5	1.5
Total	2	1.375					
R11	1	1	1	1	1	1	1
	1	0.5	1	1	1	0.5	1
Total	2	1.5					
R12	0	0					
R13	0	0					

Table 3 The modified number of manuscripts using the Scholarly Activity Point system (class of 2010). The grey area describes the total number of abstracts and the modified number of abstracts based on SAPs per resident. ID, identification number

Resident ID	Number of manuscripts	Modified number of manuscripts	Modifier 1.0. Peer-reviewed	Modifier 2.0. Authorship	Modifier 3.0. Category	Modifier 4.0. Impact factor
R1	1	3.724	1	1	1	3.724
	1	4.224	1	1	1	4.224
Total	2	7.948				
R2	1	0.531	1	1	0.5	1.062
	1	2.5	1	0.5	1	0.5
Total	2	3.031				
R3	1	1.7	1	1	1	1.7
	1	1.7	1	1	1	1.7
Total	2	3.4				
R4	1	2.982	1	1	1	2.982
Total	1	2.982				
R5	1	1.107	1	0.5	1	2.214
	1	2.079	1	0.5	1	4.157
	1	1.542	1	0.5	1	3.083
	1	0.754	1	0.5	1	1.508
Total	4	5.482				
R6	1	0.577	1	0.5	0.5	2.306
Total	1	0.577				
R7	1	1.542	1	0.5	1	3.083
	1	1.637	1	0.5	1	3.274
	1	0.827	1	1	1	0.827
Total	3	4.006				
R8	0	0				
R9	0	0				
R10	1	0.662	1	1	0.5	1.324
Total	1	0.662				
R11	1	2.079	1	0.5	1	4.157
Total	1	2.079				
R12	0	0				
R13	1	4.157	1	1	1	4.157
Total	1	4.157				

or productivity based faculty compensation programmes in academic institutions.[7][8] The incentive system and relative value unit approach has been well described, including the use of a theoretical merit matrix incentive system for faculty within a department of surgery, whose incentive system was based on productivity in the categories of academic rank, administrative duties, research, and teaching.[8] Unlike our SAP system, this reported incentive system did
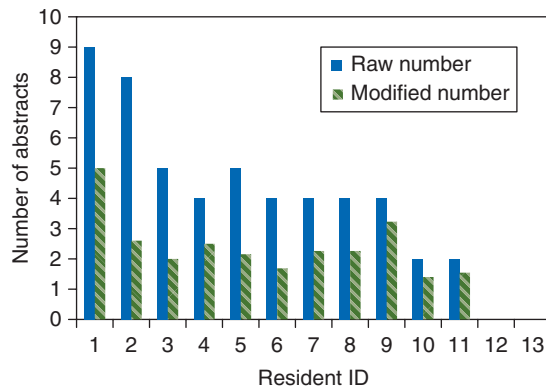
Fig 1 Comparison of abstract raw numbers and modified abstract numbers using the SAP system. In this SAP system, the modified number of abstracts has a tendency towards a depreciated value compared with the raw number of abstracts.
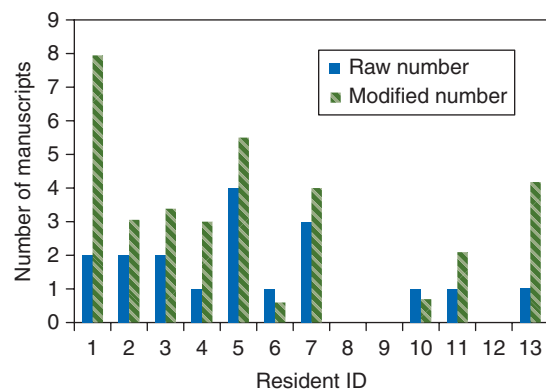

Fig 2 Comparison of manuscript raw numbers and modified manuscript numbers using the SAP system. In this SAP system, the modified number of manuscripts has a tendency towards an appreciated value compared with the raw number of manuscripts.

not publish the specific point value of various activities, leaving it to the discretion of the individual institution.[8] Our SAP system was made to be more applicable to residents, including entry level scholarly activities such as case reports, abstract presentations at local conferences, co-authorship of short book chapters, and miscellaneous other activities such as letters to the editor or non-peer-reviewed publications.

There are several potential benefits of using SAPs to evaluate resident scholarly activity. First, SAPs can be used by the ACGME to gauge the research productivity of a residency programme. The traditional approach of resident research activity evaluation often involves the completion of a minimum number of scholarly activities. With the new scoring system, a minimum number of SAPs, rather than a minimum

number of activities, would be proposed. Secondly, SAPs could serve as a tool to evaluate education initiatives designed to facilitate a resident's engagement in scholarly activities. It has already been well established that the adoption of a residency programme research curriculum or the establishment of research requirements lead to increased research activity.[16–18] Calculation of SAPs would make this trend easier to identify. Thirdly, SAPs could be used as a tool to evaluate residency programmes, or residents seeking faculty positions or fellowships. Finally, a previous study has shown a positive association between residents involved in scholarly activity and resident satisfaction.[19] Although the resident satisfaction is a complex issue with many variables, residency programmes could use SAPs to modify their curriculum, possibly impacting resident satisfaction.

The proposed SAP system has several important limitations. The list of SAP categories does not include all aspects of scholarly activity or scholarship, excluding activities that did not result in accepted abstracts at meetings or published manuscripts, intra-departmental and extra-departmental presentations, or participation in educational and leadership activities. The definition of scholarly activity itself can lead to much discussion. Ideally, one has to include all four aspects of scholarship: discovery, integration, application, and teaching.[4] [5] Additionally, our publication search was completed using PubMed, which likely carried a chance to miss unpublished abstract presentations by the residents during the study period. However, the chance of missing records particularly during the early years of the study is highly unlikely as our department has mandated the residents to report any scholarly activities at the semi-annual residency programme director meeting for the entire study period. Educational scholarly activities, leadership scholarly activities, and intra-departmental presentations were ultimately withheld because of the subjective nature of their evaluation. No clear standard or previous work exists to objectively evaluate these scholarly activities. Data on these types of scholarly activities were also not comprehensively recorded for residents. As this study was designed to start a discussion on the evaluation of scholarly activity, any comprehensive SAP system should expand the point system presented here to include other non-research scholarly activities. At this stage, this scoring system has focused on published work; not because publications are the most important element of scholarly activity, but because the objective nature of published work was ideal to demonstrate a potential utility of the new point system. Upon further consensus of each element of scholarly activity, the SAP system would need to evolve in order to be applied to the entire realm of scholarly activity, including unpublished works by residents or new online forums such as MedEdPortal (MedEdPortal® is a program of the Association of American Medical Colleges with the following website: www.mededportal.org).

There are several other important discussion points. First, we fully acknowledge that the modifiers and the relative value weights used in the SAP system were determined locally, based on the merit matrix evaluation system that

Table 4 Scholarly Activity Points per resident per graduation year during residency. [a]Raw number (mean scholarly activities per resident). [b]Number of resident (% in the class). A statistically significant increase in SAPs was found in the classes of 2009 and of 2010, respectively, compared with those of classes 2003–2006 (*$P<0.05$, §$P<0.01$ vs the class of 2009; ‡$P<0.01$, †$P<0.05$, #$P<0.001$ vs the class of 2010). SAPs, Scholarly Activity Points; SD, standard deviation

Year of graduation	2003	2004	2005	2006	2007	2008	2009	2010
Number of residents	10	11	19	14	9	15	15	13
Abstracts	11 (1.10)[a]	3 (0.27)	15 (0.79)	6 (0.43)	8 (0.90)	15 (1.00)	33 (2.20)	51 (3.90)
SAPs	362.5	56.25	512.5	225.0	212.5	531.3	893.8	1,412.5
Manuscripts	2 (0.20)	3 (0.27)	11 (0.58)	6 (0.43)	1 (0.11)	5 (0.33)	4 (0.27)	18 (1.40)
SAPs	371.3	416.7	1,575	860.7	82.65	1,153	1,185	5,063.6
Grants	1 (0.10)	0	1 (0.05)	0	0	0	0	2 (0.15)
SAPs	150	0	225	0	0	0	0	300
Book chapters	0	1 (0.09)	3 (0.16)	3 (0.21)	3 (0.30)	7 (0.47)	9 (0.60)	6 (0.46)
SAPs	0	25	75	75	75	150	225	150
Study approvals	0	0	0	0	0	1 (0.07)	0	0
SAPs	0	0	0	0	0	75	0	0
Others	1 (0.10)	0	0	0	1 (0.11)	1 (0.07)	0	4 (0.31)
SAPs	12.5	0	0	0	12.5	250	0	62.5
SAPs								
Total	896	498	2,388	1,161	383	2,159	2,316	6,815
Mean (SD)	90 (188)*‡	45 (73)*‡	126 (349)†	83 (205)§#	43 (34)	144 (210)	154 (204)	524 (471)
Median	31	0	50	0	38	50	63	328
Range	0–619	0–194	0–1550	0–767	0–88	0–650	13–808	0–1617
Zero SAPs	3 (30%)[b]	6 (55%)	5 (26%)	8 (57%)	2 (22%)	4 (27%)	0 (0%)	1 (8%)

was developed and used to calculate faculty performance-based compensation system in the anaesthesia department as fiscal year 2004 [Sakai T, Hudson ME, Davis PJ, Williams JP. Integration of Clinical and Academic Performance-Based Faculty Compensation Plans: the System and its Impact on an Anesthesiology Department. Society for Education in Anesthesia 27th Annual Meeting, Milwaukee, WI, June 1–3, 2012 (Abstract)]. More vigorous discussion would be necessary to reach the consensus on each value. Secondly, such a point system for residents could have a negative impact as well by encouraging residents to work on projects that provide the greatest number of SAPs instead of projects with more educational value. This concern could be outweighed by the possible benefit of increased academic productivity by the residents or faculty clinical productivity.[15][20] Thirdly, incorporating the IF into the point system provides a way to reward those manuscripts published in highly regarded and often-cited journals. It should be acknowledged, however, that the IF is a mathematical measure of the journal's citation rate, and not a quality measure of any individual article. Fourthly, the trend toward increased scholarly activity within this residency programme likely exists because of a number of factors. This includes an increased availability and mentorship of faculty to promote and facilitate scholarly activity completion and submission, an increased emphasis within the residency programme to complete a research project that ultimately ends in manuscript submission, new mandatory research problem-based learning discussions (PBLDs) that de-mystify the manuscript, case report, and abstract submission process, and the development of a Resident Research Director position (in 2007). As this

point system was developed after the study period was completed, there should not be the observer effect because of the measurement.

In summary, a new evaluation system, SAPs, is proposed for residents' scholarly activities. A new scoring system enabled a comprehensive statistical evaluation of residents' scholarly productivity.

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Declaration of interest

None declared.

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