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AAS/SUS Research Awards Are Highly Successful in Fostering Future Surgeon-Scientists

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Abstract

Introduction: The surgeon-scientist brings a unique perspective to surgical research. The Association of Academic Surgeons (AAS) and Society of University Surgeons (SUS) foster the development of surgeon-scientists through foundation awards to residents and junior faculty. We sought to evaluate the academic success of surgeons who received an AAS/SUS award.

Methods: Information was collected for individuals who received a resident or junior faculty research award from the AAS or SUS. Google Scholar, Scopus, and the NIH RePORTER were used to assess scholarly achievements.

Results: Eighty-two resident awardees were included, 31 (38%) of whom were female. Thirteen (24%) are now professors, 12 (22%) are division chiefs, and 4 (7%) are department chairs. Resident awardees have a median 886 citations (IQR 237–2,111) and H-index of 14 (IQR 7–23). Seven (13%) went on to receive K08/K23 awards and 7 (13%) received R01s with a total of about \$200 million in NIH funding (79-fold return on investment). Thirty-four junior faculty awardees were included, 10 (29%) of whom were female. Thirteen (38%) are now professors, 12 (35%) are division chiefs, and 7 (21%) are department chairs. Faculty awardees have a median 2,617 citations (IQR 1,343–7,857) and H-index of 25 (IQR 18–49). Four (12%) received K08 or K23 awards and 10 (29%) received R01s, with about \$139 million in NIH funding (98-fold return on investment).

Conclusions: AAS/SUS research awardees experience high degrees of success in academic surgery. The majority of resident awardees pursue fellowship training and remain in academic

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surgery. A high percentage of both faculty and resident awardees hold leadership positions and successfully achieve NIH funding.

Two-Sentence Article Summary:

The AAS/SUS research awardees experience a high degree of success in academic surgery. The majority of resident awardees pursue fellowship training and remain in academic surgery, while a high percentage of both faculty and resident awardees hold leadership positions and successfully achieve NIH funding.

Introduction:

The surgeon-scientist brings a unique perspective to surgical research. Their position as a “bridge tender”¹ between clinical surgery and biologic science provides an opportunity to find solutions to critical surgical problems. Though a noble endeavor, the road to becoming a successful surgeon-scientist is not without its obstacles. Aspiring surgeon-scientists face challenges including competing administrative demands, lack of protected time or departmental support, and pressures of being clinically productive². In addition to these obstacles, the competitive funding environment is a significant burden for surgeon-scientists, as the success rate for surgeon scientists concerning NIH grants with surgeons as principal investigators is only 16.4%³.

Recognizing this, many surgical societies, including as the Association for Academic Surgery (AAS), the Society of University Surgeons (SUS), the American College of Surgeons (ACS), and others, seek to foster the development of surgeon-scientists by offering research awards to residents and junior faculty. For residents, the awards are intended to be applied to 1–2 years of dedicated postgraduate research training, offering residents the ability to take dedicated time away from clinical responsibilities in order to focus on research and offsets the financial burden on the residents, their surgery departments, and their mentors as they pursue their research goals. Faculty awards are generally intended for junior faculty in their first five years of practice who are pursuing basic or clinical science research. For many, this sponsorship supplements departmental support of surgical investigators and facilitates early work that becomes the basis for larger extramural funding applications.

These societal awards for residents and junior faculty are unique in that they are provided at a critical period in the surgeon-scientist’s development, in which the research is often in its infancy and not yet robust enough to merit National Institutes of Health (NIH) or other extramural funding. Surgical society research awards serve as catalysts for further research and as seed funding for those looking to jumpstart their research careers and build on their goals of academic advancement with hopes of receiving larger grants, such as mentored career development awards⁴. In this manuscript, we examine the residents and junior faculty who have been awarded research awards from the AAS and SUS and evaluate their subsequent academic success.

Methods:

A descriptive study was performed for resident recipients of the AAS Trainee Research Fellowship Award or the SUS Resident Scholar Award between 1987 and 2021 as well as for faculty recipients of the AAS Joel J. Roslyn Faculty Research Award and SUS Junior Faculty Research Scholar Award between 1997 and 2022. Residents who received the ACS Resident Research Scholarship between 1970 and 2016 were also analyzed for comparison. Unpublished data from a 2017 survey of 1,033 AAS/SUS members² was used to represent the general academic surgical population for comparison. Recipients who were not listed on the award websites of the respective societies or could not be identified at the time of this study were not included. This study was exempt from institutional review board approval as all information was obtained through publicly available data.

Google Scholar, Scopus, and the National Institutes of Health Research Portfolio Online Reporting Tools: Expenditures and Results (RePORTER) databases were used to assess scholarly achievements. Demographic information collected included sex, advanced degree(s), practice type, and fellowship specialty. Scholarly achievement measures collected included current title, academic appointments to division chief or department chair, number of publications following award, number of citations, H-index, and NIH grants obtained following award. Measures of scholarly achievement are reported only for surgeons who have completed training at the time of this study. Obtention of K08, K23, and R01 grants were the primary measures of academic success. Data on other R-series, K-series, and P-series NIH grants were also collected. The number of publications prior to the award were queried for comparison. Data were analyzed descriptively and with unpaired t-tests and Fisher's exact test using Stata version 17.0 (StataCorp, College Station, Texas).

Results:

Eighty-four residents received research awards from the AAS and SUS between 1987 and 2021, with 18 receiving the AAS Trainee Research Fellowship Award and 66 receiving the SUS Resident Scholar Award. Two resident awardees could not be identified and were thus excluded from analyses. Therefore, a total of 82 AAS and SUS (AAS Trainee Research Fellowship Award, n=18; SUS Resident Scholar Award, n=64) resident awardees were included in the study. Thirty-one (38%) of the residents were female. At the time of this study, 68 (83%) had graduated residency and, of those, 54 (79%) had completed fellowship training, with surgical oncology (n=11, 20%), abdominal transplant/hepatobiliary surgery (n=10, 19%), and pediatric surgery (n=9, 17%) being the most common fellowship specialties. Of the 54 surgeons that completed training, 42 (78%) remain in academic surgery, and of those, 13 (31%) hold a title of professor, 12 (29%) hold a division chief position, and 4 (10%) hold a department chair position. A total of 21 (39%) resident awardees, who have now completed training, went on to obtain an NIH grant, while 15 (28%) obtained any R-series, K-series, or P-series NIH grants. Seven (13%) resident awardees obtained K08 or K23 grants, and four of them converted the K08 or K23 to an R01. Seven (13%) total resident awardees obtained R01 grants, and ten (19%) obtained other R-series, K-series, or P-series NIH grants for a total of about \$200 million in NIH funding (79-fold return on investment), when all NIH funding mechanisms are considered. When

assessing the number of publications at 5 years following foundation award for residents awarded between 2002 and 2017, those who went on to receive a K08, K23, or R01 did not have a significantly different number of publications at 5 years compared to those that did not receive those NIH grants [14 [IQR 10–28] vs. 12 (IQR 6–22), $p=0.55$]. Resident awardees had a median of 29 total post-award publications (IQR 13–75), 886 citations (IQR 237–2,111), and a median H-index of 14 (IQR 7–23) (Table 1). When compared to ACS Resident Research Scholarship awardees, AAS/SUS awardees had more publications than ACS resident awardees prior to receiving their awards [1 (IQR 0–6) vs. 0 (IQR 0–4), $p=0.01$]. However, there were no significant differences in academic titles, achievement of chief/chair positions, number of publications after receiving the award, H-index, number of citations, or NIH grants received between AAS/SUS and ACS resident awardees (Tables 2,3). Notably, the proportion of ACS awardees who received R01 grants ($n=28$, 18%) was nearly double that in the AAS/SUS group ($n=7$, 13%), but this difference was not statistically significant ($p=0.53$).

Thirty-six faculty received junior faculty research awards from the AAS and SUS from 1997–2022 with 17 being awarded the AAS Joel J. Roslyn Faculty Research Award and 19 receiving the SUS Junior Faculty Research Scholar Award. Two faculty could not be identified and were excluded from analysis resulting in 34 (AAS Joel J. Roslyn Faculty Research Award, $n=16$; SUS Junior Faculty Research Scholar Award, $n=18$) junior faculty research awardees included. Four (12%) of the included faculty had previously received AAS or SUS resident research awards. Ten (29%) junior faculty awardees were female. Thirty-three (97%) completed a fellowship, with surgical oncology ($n=14$, 40%) and pediatric surgery ($n=7$, 21%) being the most common specialties. Thirty-two (94%) remain in academic surgery. Thirteen (38%) hold a title of professor, while 12 (35%) hold a division chief position, and 7 (21%) are department chairs. A total of 19 (56%) junior faculty awardees hold chair or division chief positions compared to the 30% of AAS/SUS reference population² that hold chair or division chief positions. Faculty awardees had a median 45 total post-award publications (IQR 24–122), 2,617 citations (IQR 1,343–7,857), and a median H-index of 25 (18–49). A total of 17 (50%) junior faculty awardees went on to obtain an NIH grant, compared to 36.1% of AAS/SUS NIH funded faculty in our reference group², while 16 (47%) obtained any R-series, K-series, or P-series NIH grants. Four (12%) junior faculty awardees went on to obtain K08 or K23 funding, and 2 of the awardees converted their K08 or K23 awards to an R01. Ten (29%) total awardees obtained R01 funding and 9 (26%) obtained other R-series, K-series, or P-series NIH grants for a total of about \$139 million in NIH funding (98-fold return on investment), when all NIH funding mechanisms are considered. When assessing the number of publications at 5 years following foundation award for faculty awarded between 2002 and 2017, those who went on to receive a K08, K23, or R01 did not have a significantly different number of publications at 5 years compared to those that did not receive those NIH grants [37 (IQR 10–49) vs. 20 (IQR 11–36), $p=0.36$]. The median number of years from faculty award to NIH funding was 3 (IQR 1–5) (Table 4).

Discussion/Conclusion:

The AAS and SUS offer research awards for residents and junior faculty that may be used to jumpstart a career as a surgeon-scientist. Recipients of resident and junior faculty research awards generally go on to have high scholarly impact and a large proportion of awardees ascend to leadership positions when compared to the general population of AAS/SUS members. Thirty-nine percent of resident awardees and 50% of junior faculty awardees successfully obtain NIH funding in comparison to 36% of the general population of AAS/SUS members. Furthermore, 56% of junior faculty awardees later become division chiefs or department chairs compared to 30% of the general AAS/SUS members.² Many awardees obtained additional funding via both mentored and investigator-initiated NIH grants with a high return on investment for the dollar amount awarded. Collectively, these results highlight the efficacy of foundation awards in supporting the early career surgeon-scientist.

Recent reductions in NIH funding disproportionately impact the surgeon-scientist³. In addition, the challenge of starting a lab while building a surgical practice creates a unique dilemma for the young surgeon-scientist^{5, 6}. For example, it has been described that it takes a surgeon-scientist longer to be granted a career development award than an internal medicine physician⁷. In this crucial period, during which an early-stage surgeon-scientist may have limited time and resources for research, foundation research awards provide a critical source of support that fosters the growth of ideas and translates into future academic productivity. In addition to monetary support, protected time, mentorship, and support from leadership are key factors in obtaining K-awards, as noted by surgeon-scientists that had received a K-award from 2008–2018⁸. Many foundation awards, including the AAS/SUS awards, require applicants to outline a plan for protected time and mentorship which may encourage potential awardees to seek these resources that then place them in a favorable position to obtain additional grants. Our results show that recipients of AAS/SUS resident and junior faculty research awards are highly successful in achieving NIH funding after receiving a foundation award. We found that awardees who successfully achieve NIH funding tended to have a higher median number of publications following their foundation award, but this was not significantly different. This highlights the fact that, while productivity is important during the award period, there are likely numerous other factors involved in the successful conversion of a foundation award to a mentored or individual NIH research grant. Foundation awards are an important source of support for nascent research, but it is incumbent upon the awardee to utilize its full potential.

To set surgeon-scientists up for success, surgery departmental leaders name “clear research goals and plans for attaining funding” and “embedding early surgeon-scientists in their scientific mentors’ labs in a post-doctoral model” as ingredients for success⁹. These ingredients are embedded into the AAS/SUS resident and junior faculty research awards. The applications for the awards require thoughtful planning, formulation, and presentation of the aims of the proposed project, often in close consultation with a mentor. Following receipt of the award, awardees are required to provide progress reports and receive additional feedback on how to develop and improve their research plans. By the end of the

process, the award recipients are likely to have developed a robust application for extramural funding which may translate into success in achieving NIH funding.

It is important to consider diversity, equity, and inclusion in the support of surgeon-scientists. While the number and dollar-amount of funding of women surgeon-scientists has increased over the past decade¹⁰, there is still progress to be made. Roughly 30% of AAS/SUS award recipients throughout the studied time-period are female. However, in the last 5 years, 8 out of 16 of resident awardees (50%) and 5 out of 10 faculty AAS/SUS awardees were female (50%). This shift represents the changing landscape of surgery: 26%¹¹ of surgeons practicing in academic departments identify as female compared to 45.2%¹² of surgeons in training. As our results show that resident and junior faculty research awards are a stepping-stone toward academic success, these foundation awards can be instrumental in promoting diversity, equity, and inclusion among surgeon-scientists. The race and socioeconomic background of awardees were not examined in this study but need to be considered in future studies.

This study has several limitations. Importantly, the definition of academic success in this study is limited to publications, promotions, and NIH funding. Additional scholarly achievements and publications such as book chapters, invited presentations, and media appearances are not reflected in our results, creating a biased representation of scholarly achievement. Furthermore, extramural grants obtained via mechanisms outside the NIH were not included in our assessment of scholarly achievement, resulting in a biased view toward NIH-funded surgeon-scientists. Finally, we did not assess other immeasurable but invaluable aspects of academic surgery, such as the impact of teaching and mentorship. Scholarly achievement was determined via public sources: Google Scholar, Scopus, and NIH RePORTER. Reported sex may not correspond with individual self-identifications, and information related to academic rank or position may be outdated on the institutional websites from which they were collected. Lead time bias is a limitation of our comparison of the AAS/SUS and ACS resident foundation award recipient groups, as the ACS awards recipients available extended back to 1970 whereas the AAS/SUS recipients were only available as early as the year 1987. This lead time bias may account for the higher number of R01 grants in the ACS award group. Lastly, as information about past applicants for these foundation awards is kept confidential, it was not possible to compare the academic success of award winners with the applicants who did not receive the awards. As such, we cannot ascertain if the AAS/SUS awards themselves enable success, or if the foundations are selecting candidates who are already primed to succeed. The group we used for comparison, which represents the general population of AAS/SUS members in 2017, may not be an equivalent comparison group.

Despite these limitations, metrics of scholarly achievement are consistent in demonstrating that AAS/SUS resident and junior faculty award recipients achieve high degrees of success in academic surgery. The majority of resident awardees pursue fellowship training and remain in academic surgery. A high percentage of both faculty and resident awardees hold leadership positions and go on to successfully obtain NIH funding. It behooves us, then, to continue to support the foundations that support these awards and encourage our mentees and trainees to pursue them.

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Abbreviations:

AAS	Association for Academic Surgery
SUS	Society of University Surgeons
ACS	American College of Surgeons
NIH	National Institutes of Health
RePORTER	Research Portfolio Online Reporting Tools: Expenditures and Results

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Table 1.**AAS/SUS Resident Awardee Demographics and Academic Achievement**

Total Number	82
Female	31 (38%)
Degree	
MD/DO	57 (70%)
MD/DO, MPH/MS/MA	9 (11%)
MD/DO, MBA	2 (2%)
MD/DO, PhD	13 (16%)
MD/DO, PhD, MBA	1 (1%)
Completed Training at Time of Study	54 (66%)
Fellowship Specialty [#]	
No Fellowship	10 (19%)
Surgical Oncology	11 (20%)
Pediatric Surgery	9 (17%)
Critical Care/Trauma Surgery	1 (2%)
Abdominal Transplant/Hepatobiliary Surgery	10 (19%)
Thoracic/Cardiac Surgery	3 (6%)
Vascular Surgery	2 (4%)
Minimally Invasive/Bariatric/Gastrointestinal Surgery	1 (2%)
Spine/Neurosurgery	0 (0%)
Plastics/Hand/Microsurgery	2 (4%)
Colon/Rectal Surgery	3 (6%)
Endocrine Surgery	0 (0%)
Non-surgical Fellowship	2 (4%)
Title [#]	
Professor	13 (24%)
Associate Professor	11 (20%)
Assistant Professor	16 (30%)
Clinical Instructor	2 (4%)
Non-Academic	12 (22%)
Division Chief Position [#]	12 (22%)
Department Chair Position [#]	4 (7%)
Median Number of Publications Prior to Award	1 (0–6)
Median Number of Publications Following Award	29 (13–75)
Median Number of Citations	886 (237–2,111)
Median H-Index	14 (7–23)
Awarded K08 or K23 [#]	7 (13%)
Awarded R01 [#]	7 (13%)

#Results only include awardees that have completed training

Categorical variables represented as n (%). Continuous variables represented as median (interquartile range).

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Table 2.

ACS Resident Awardee Demographics and Academic Achievement

Total Number	165
Female	45 (27%)
Degree	
MD/DO	127 (77%)
MD/DO, MPH/MS/MA	8 (5%)
MD/DO, MBA	3 (2%)
MD/DO, PhD	26 (16%)
MD/DO, PhD, MBA	1 (1%)
Completed Training at Time of Study	158 (96%)
Fellowship Specialty [#]	
No Fellowship	33 (21%)
Surgical Oncology	11 (7%)
Pediatric Surgery	26 (16%)
Critical Care/Trauma	8 (5%)
Abdominal Transplant/Hepatobiliary	12 (8%)
Thoracic/Cardiac	24 (15%)
Vascular	11 (7%)
Minimally Invasive/Bariatric/Gastrointestinal	9 (6%)
Spine/Neurosurgery	5 (3%)
Plastics/Hand/Microsurgery	11 (7%)
Colon/Rectal Surgery	3 (2%)
Endocrine	3 (2%)
Non-surgical fellowship	2 (1%)
Title [#]	
Professor	41 (26%)
Associate Professor	30 (19%)
Assistant Professor	32 (20%)
Clinical Instructor	3 (2%)
Non-Academic	52 (33%)
Division Chief Position [#]	33 (21%)
Department Chair Position [#]	24 (15%)
Median Number of Publications Prior to Award	0 (0–4)
Median Number of Publications Following Award	39 (16–99)
Median Number of Citations	1,386 (379–3,460)
Median H-Index	16 (9–30)
Awarded K08 or K23 [#]	18 (11%)
Awarded R01 [#]	28 (18%)

#Results only include awardees that have completed training

Categorical variables represented as n (%). Continuous variables represented as median (interquartile range).

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Table 3.

Comparison of Outcomes Between ACS and AAS/SUS Resident Awardees

	ACS n=165	AAS/SUS n=82	P value
Title [#]			
Professor	41 (26%)	13 (24%)	0.86
Associate Professor	30 (19%)	11 (20%)	0.84
Assistant Professor	32 (20%)	16 (30%)	0.19
Clinical Instructor	3 (2%)	2 (4%)	0.60
Non-Academic	52 (33%)	12 (22%)	0.17
Division Chief Position [#]	33 (21%)	12 (22%)	0.85
Department Chair Position [#]	24 (15%)	4 (7%)	0.17
Median Number of Publications Prior to Award	0 (0–4)	1 (0–6)	0.01
Median Number of Publications Following Award	39 (16–99)	29 (13–75)	0.47
Median Number of Citations	1,386 (379–3,460)	886 (237–2,111)	0.12
Median H-Index	16 (9–30)	14 (7–23)	0.06
Awarded K08 or K23 [#]	18 (11%)	7 (13%)	0.81
Awarded R01 [#]	28 (18%)	7 (13%)	0.53

[#]Results only include awardees that have completed training

Categorical variables represented as n (%). Continuous variables represented as median (interquartile range).

Table 4.**AAS/SUS Faculty Awardee Demographics and Academic Achievement**

Total Number	34
Female	10 (29%)
Degree	
MD/DO	23 (68%)
MD/DO, MPH/MS/MA	2 (6%)
MD/DO, MBA	0 (0%)
MD/DO, PhD	9 (27%)
Fellowship Specialty	
No Fellowship	1 (3%)
Surgical Oncology	14 (41%)
Pediatric Surgery	7 (21%)
Critical Care/Trauma	0 (0%)
Abdominal Transplant/Hepatobiliary	1 (3%)
Thoracic/Cardiac	2 (6%)
Vascular	3 (9%)
Minimally Invasive/Bariatric/Gastrointestinal	2 (6%)
Spine/Neurosurgery	1 (3%)
Plastics/Hand/Mi crosurgery	1 (3%)
Colon/Rectal Surgery	1 (3%)
Endocrine	1 (3%)
Title	
Professor	13 (38%)
Associate Professor	6 (18%)
Assistant Professor	13 (38%)
Clinical Instructor	0 (0%)
Non-Academic	2 (6%)
Division Chief Position	12 (35%)
Department Chair Position	7 (21%)
Median Number of Publications Prior to Award	23 (15–39)
Median Number of Publications Following Award	45 (24–122)
Median Number of Citations	2,617 (1,343–7,857)
Median H-Index	25 (18–49)
Median Years to NIH Grant Following Award	3 (1–5)
K08/K23 Prior to Award	2 (6%)
K08/K23 Following Award	4 (12%)
R01 Prior to Award	0 (0%)
R01 Following Award	10 (29%)

Categorical variables represented as n (%). Continuous variables represented as median (interquartile range).