Emergency Medicine Research: 2030 Strategic Goals

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NK	X	X	X	X		N/A
RL		X	X	X		N/A
CN		X	X	X		N/A
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Abstract

All academic medical specialties have the obligation to continuously create new knowledge that will improve patient care and outcomes. Emergency medicine (EM) is no exception. Since its origins over 50 year ago, EM has struggled to fulfill its research mission. EM ranks last among clinical specialties in the percent of medical school faculty who are NIH-funded principal investigators (PIs) (1.7%) and percent of medical school departments with NIH-funded PIs (33%). Although there has been a steady increase in the number of NIH-funded projects and total NIH dollars, the slowing growth in the number of NIH-funded PIs and lack of growth in the number of EM departments with NIH-funded PIs is cause for concern. In response, the AACEM Research Task Force proposes a set of 2030 strategic goals for the EM research enterprise that are based on sustaining historic growth rates in NIH-funding. These goals have been endorsed by the AACEM Executive committee and the Boards of SAEM, ACEP and AAEM. The 2030 strategic goals include 200 NIH-funded projects led by 150 EM PIs in at least 50 EM Depts with over $100M in annual funding resulting in over 3% of EM faculty being NIH-funded PIs. Achieving these goals will require a targeted series of focused strategies to increase the number of EM faculty who are competitive for NIH funding. This requires a coordinated intentional effort with investments at the national, departmental and individual levels. These efforts are ideally led by medical school department chairs, who can create the culture and provide the resources needed to be successful. The specialty of EM has the obligation to improve the health of the public and to fulfill its research mission.

Background

The Association of Academic Chairs of Emergency Medicine (AACEM) commissioned a
Research Task Force in 2020 with objectives that included: 1) assessing and disseminating the
current state of research funding in academic emergency medicine (EM) departments and 2)
engaging the EM community to set 10-year targets for research funding among academic EM
departments. The Task Force analyzed federal research funding data from publicly available
sources and medical school faculty data from the American Association of Medical Colleges
(AAMC) to benchmark the current state of EM research funding against other clinical specialties
and analyze historical trends. The Task Force recognized that these data only attribute awards
to contact PIs, and do not include NIH funding to institutions other than medical schools, funding
to EM divisions within non-EM departments, and funding contracts or Small Business Innovation
Research (SBIR) and Small Business Technology Transfer (STTR) grants. Therefore, not all
funding to EM investigators is captured. This analysis was used to develop the 2030 goals for
NIH funding described in this manuscript. These goals were voted on and unanimously
supported by the AACEM Research Task Force membership and the American College of
Emergency Physicians (ACEP)-Society for Academic Emergency Medicine (SAEM) Federal
Research Funding Workgroup. The AACEM Executive Committee and the Boards of SAEM,
ACEP, and the American Academy of Emergency Medicine (AAEM) subsequently endorsed the
goals. A writing group comprised of the AACEM Research Task Force and representatives
from the SAEM, ACEP, and AAEM was formed to generate this manuscript which reports the
rationale for setting the 2030 goals, the data used to generate the goals, and recommended
strategies to achieve them. The scope of these recommendations is internal facing to the
academic emergency medicine community.

Importance of Research in the Tripartite Mission of Emergency Medicine

Any academic medical specialty must continuously create new knowledge that will improve patient outcomes. To be maximally effective, the scope of research activities should span the entire translational spectrum, from basic science through clinical science, implementation and health policy research. Clinicians who provide patient care within the specialty must be engaged in the research enterprise to assure that the most important and relevant knowledge gaps are being addressed. Finally, it is the obligation of academic departments within the specialty to recruit, train, and support the scientists who will create and disseminate the new knowledge needed to advance the specialty in the future. The specialty of EM is no exception.

The potential impact of improved emergency care in reducing human suffering is immense. In 2018 there were 130 million (M) emergency department (ED) visits resulting in 16.2 M hospitalizations and 2.3 M critical care unit admissions.[1] These patients deserve the best possible care based on current science and best evidence, and improvements in care are driven by new science. Although many clinical specialties provide emergency care and are involved in emergency care research, the specialty of EM would be delinquent in its duty if it simply relied on scientists outside the specialty to advance the field.

History of Emergency Medicine Research

After the first meeting with the American Board of Medical Specialists, it was crystal clear to the EM representatives that If EM was to become a distinct medical specialty, it would require a unique scientific and clinical basis, as well as recognition as a unique academic endeavor, separate from the clinical activity and bedside medical education. The nascent field was tasked with detailing a body of knowledge and expertise that was unique to the specialty. EM was a response to the need to provide a higher quality of care for all patients with acute illnesses and

injuries. The recognition of this need was highlighted in 1966 when the National Academy of Sciences report titled "*Accidental Death and Disability: The Neglected Disease of Modern Society,*" which noted that society was not aware of "the magnitude of the problem of accidental death and injury".[2] Furthermore, the report noted that the standards for US ambulance services were varied and "often low" and that ambulances were either unsuitable, ill-equipped, or staffed by untrained personnel. This publication resulted in the first federally qualified ambulance services and personnel, the training of whom fell onto EM. In 1973, Congress passed the Emergency Medical Services Systems Act, which directed the Secretary of Health, Education, and Welfare to provide grant funding to study the feasibility of establishing and operating an emergency medical services (EMS) system. Early EM research focused primarily on the newly established EMS system and emergent therapies.

Although this act was helpful, it was not sufficient to support the formation of an entire new research specialty. Early EM research was focused primarily on narrow clinical questions, which was inconsistent with the model and priorities of federal funders and larger foundations. Though the AMA and the specialty board recognized the clinical specialty of EM, the academic portion of EM was stagnant. In 1994, the Macy report entitled, *The Role of Emergency Medicine in the Future of American Medical Care* provided a defined road map for the future development of academic EM.[3] Along with recommendations for the creation of university departments and required medical school rotations, it also recommended the development of modern, scientifically and methodologically sophisticated research programs that would be competitive for federal funding. These programs included: (1) a cadre of rigorously trained investigators with dedicated research time and resources, similar to those of their peers housed in other clinical departments; (2) productive collaborations with experienced, federally-funded investigators across medical and scientific disciplines; and (3) the development and sustenance of funding and other resources for the most promising research activities. In 2003, a published

update on the implementation of the original Macy report recommendations noted persistent

gaps in federal support for EM.[4]

In 2006, the Institute of Medicine published three coordinated reports focused on the Future of

Emergency Care in the U.S. Health System,[5-7] and recommended "…that the Secretary of the

Department of Health and Human Services conduct a study to examine the gaps and

opportunities in emergency and trauma care research, and recommend a strategy for the

optimal organization and funding of the research effort. This study should include consideration

of training of new investigators, development of multicenter research networks, funding of

General Clinical Research Centers that specifically include an emergency and trauma care

component, involvement of emergency and trauma care researchers in the grant review and

research advisory processes, and improved research coordination through a dedicated center

or institute." EM responded in 2007 by creating the ACEP-SAEM Joint Task Force on

Emergency Care Research.   Members of the Task Force met with the NIH Director at the time,

Dr. Elias Zerhouni, to advocate for the recommendations outlined in the IOM report.[8] An

internal NIH Task Force on Emergency Care Research, led by Walter Koroschetz, was formed

in 2007,[9] and coordinated three NIH-hosted roundtables focused on medical-surgical, trauma

and neurologic and psychiatric emergency research that identified key knowledge gaps and

recommended strategies for advancing research in these areas.[10-12] The ACEP-SAEM Joint

Task Force on Emergency Care Research had a follow-up meeting with the subsequent NIH

Director, Dr. Francis Collins, in 2011 to further advocate for implementation of the IOM

recommendations. These activities ultimately led to the creation of the NIH Office for

Emergency Care Research (OECR) in 2012.Dr. Jeremy Brown became the first permanent

OECR Director in 2013. The OECR works across the 27 institutes and centers at NIH to foster,

coordinate, and advocate for clinical and translational emergency care research and research

training.

Significant milestones in federal support for emergency care research have been achieved over the past two decades. These include the creation of multicenter clinical research networks such as the Pediatric Emergency Care Applied Research Network (PECARN, 2001 to present), the Resuscitation Outcomes Consortium (ROC, 2004-2015), the Neurologic Emergencies Treatment Trials Network (NETT, 2006 to 2017), and the Strategies to Innovate Emergency Care Clinical Trials (SIREN) Research Network (2017 to present). The first NIH K12 Career Development Program in Emergency Care Research was created by the National Heart Lung and Blood Institute (NHLB)I in 2011 (see additional details below). This was followed by a second NIH K12 Program in Emergency Care Research initiated in 2016 that was co-sponsored by NHLBI, the National Institute of Mental Health (NIMH), and the National Institute of Nursing Research (NINR).

Benchmarking EM Faculty and Departments Against Other Clinical Specialties

One method of assessing the status of research in EM specialty is to benchmark faculty and academic departments against other specialties. An appealing and most feasible option is to use NIH funding, which is the largest research funding source for all clinical specialties, and annual data is publicly available. Figure 1A illustrates the percentage of full-time medical school faculty that were NIH-funded principal investigators (PIs) in the Association of American Medical Colleges (AAMC) recognized clinical specialties in 2019. EM ranks last at 1.7% (mean 8.1%, median 6.1%). In terms of the percentage of AAMC-recognized departments with NIH-funded faculty, EM again ranks last at 33% (mean 54%, median 51%, Figure 1B). Potential contributing factors are the low percentages of MD/PhDs and PhDs (without an MD) among faculty in medical school Departments of EM with rankings of "last" in both categories. Only 3% of EM medical school faculty are MD/PhDs compared to a mean of 8.3% for all clinical specialties

(Figure 1C). Similarly, only 2.1% of EM medical school faculty are PhDs (without an MD) compared to a mean of 15.5% for all clinical specialties (Figure 1D).

Not surprisingly, there is a "strong" correlation between the percentage of full-time faculty with PhD or other doctoral degrees and the percentage of full-time faculty who are NIH-funded PIs in a department. The adjusted R^2 for the percentage of MD-PhDs is 0.72 (i.e., this explains 72% of the variability in the percentage of full-time faculty who are NIH-funded PIs) (Supplementary Figure 1A). For faculty members who are PhDs or hold another doctoral degree the adjusted R^2 is 0.63. (Supplementary Figure 1B). These data suggest that strong consideration should be given to recruiting faculty members with PhD and other doctoral degrees into medical school Departments of EM.

Despite this, the available evidence indicates that the success rate of NIH grant applications submitted by EM faculty is comparable to the success rate of faculty from other clinical specialties. Consistent with the absence of a difference in success rates, the annual number of NIH applications per 100 faculty correlates strongly with the percentage of full-time faculty who are NIH-funded PIs (R^2 0.90 ; p=0.03), (Supplementary Figure 2). Therefore, increasing the annual number of NIH grant submissions by EM faculty should be a major focus in future years as we strive to reach the goals presented below.

Emergency Medicine NIH Funding Trends

The fact that EM ranks last among clinical specialties in all the NIH benchmarks described above should be considered in the context of the youth of the specialty and growth that has been achieved over the past several decades (Figure 2A). In 2000 there were 12 NIH funded projects with EM PIs for a total of $3.9M in funding. In 2020, 150 projects were NIH funded with EM PIs, for a total of $91.5M.

It is encouraging that the number of NIH-funded EM PIs increased by 63% and the number of NIH-funded PIs per funded department increased by 50% over the past decade (Figure 2B). However, the absolute number remains relatively small and growth has been minimal in the last 3 years. Additionally concerning is the fact that the number of EM departments with NIH-funded PIs has only increased by 9% in the past 10 years and appears to be reaching a plateau. With only 33% of medical school EM departments with NIH-funded PIs relative to an average of 54% across all clinical specialties, increasing the number of EM departments with NIH-funded PIs is an essential strategy moving forward.

Individual and institutional NIH Career Development Awards (i.e., K Awards) provide a critical mechanism by which EM faculty can have dedicated research time, structured mentorship, and funding to develop into independent federally funded PIs. As illustrated in Figure 2C, the growth of active individual K-awardees has been significant since 2000 but limited in the past decade. Comparing 2010 to 2020, however, the number of active K23 awardees (n=15) and K08 awardees (n=5) is unchanged.

The National Heart, Lung, and Blood Institute (NHLBI) of the NIH funded six departments of EM in 2011 to initiate institutional K12 training programs in emergency care research training. [13] This multi-site K12 program marked the first large-scale NIH investment in emergency care research training for clinician-scientists. The K12 program was interdisciplinary by design, reflecting clinician-scientists from multiple specialties functioning under the umbrella of "emergency care". The primary goals of the K12 program were for each faculty scholar to submit and secure an individual career development award (CDA), e.g., K23 and K08 awards or a federal research project grant (RPG), e.g., R01 or R21 awards, to generate peer-reviewed emergency care research publications, and more broadly to catalyze the field of emergency

care research. Of the 43 scholars across the original six K12 sites, 40 (93%) submitted a CDA or RPG application. In an evaluation completed shortly after completion of the first 5-year funding cycle, 26 (60%) scholars had secured independent grant funding (19 CDAs and 8 RPGs, with one scholar receiving both). Overall funding success rates were 61% for CDAs and 50% for RPG applications, which exceeded overall NIH success rates for K08/K23 applications (37%) and RPG applications (17%) during a similar time period.[14] This program was renewed with support from multiple NIH institutes (NHLBI, NIMH and NINR) for a second round of funding beginning in 2016. Four training centers were awarded funding. To date, all sites have filled available training slots, with multiple scholars securing CDAs. However, the program ends in June 2021 with no plan for renewal.

The Ruth L. Kirschstein Institutional National Research Service Award (T32) is another well-established NIH funding mechanism for institutions to support pre-doctoral and post-doctoral research training slots. Although commonly used by other clinical specialties to support research training of residents and fellows, as of 2020 only two T32 grants have been awarded to Departments of EM with an additional T32 grant focused on pediatric emergency care. To mitigate the loss of the K12 program, an important strategy moving forward will be to increase the number of T32 training grant applications submitted by departments of EM.

Individual NIH institutes have established career development awards tailored towards the needs of early career emergency physicians. For example, the National Institute on Aging (NIA) developed the GEMSSTAR program to provide support for early career physician-scientists trained in medical or surgical specialties, including EM, to launch careers as future leaders in aging- or geriatric-focused research. The GEMSSTAR award is intended to offer support in a particularly vulnerable time in a new clinical faculty member's career.[15] The GEMSSTAR program also provides an opportunity for a companion award for a professional development

plan (PDP). These PDP awards are supported by professional societies and coordinated by the

American Geriatric Society.[16] The EM GEMSSTAR PDP awards are supported by the SAEM

Foundation.[17] Another NIA program to develop specialty based (including EM) research career

awards includes the Paul B. Beeson Emerging Leaders Career Development Award in Aging,

which is supported by the NIA, American Federation for Aging Research, and the John A.

Hartford Foundation.[18]

In summary, the EM specialty has made significant progress in NIH funding over the past two

decades. However, the number of individual K awards has plateaued. Although the NIH-funded

K12 Career Development Programs in Emergency Care Research were successful, they have

ended despite a persistent need to develop scientists focused on emergency care research.

Finally, while the overall number of NIH-funded PIs has grown, the number of departments with

NIH-funded PIs has not and remains relatively low compared to other specialties.

Other Federal Funding Sources for Emergency Medicine Research

While NIH provides most of the research funding to the specialty of EM, other federal and non-

federal sources are strategically important. Federal funding from the Agency for Healthcare

Research and Quality (AHRQ), Centers for Disease Control (CDC), Veterans Administration

(VA), Department of Defense (DOD), Biomedical Advanced Research Development Authority

(BARDA), Patient-Centered Outcomes Research Institute (PCORI), Health Resources and

Service Administration (HRSA), and Substance Abuse and Mental Health Services

Administration (SAMHSA) provides important research funding to EM investigators, especially

for research areas not typically funded by the NIH. Supplemental Figure 3 illustrates historical

funding trends for AHRQ and CDC. Since its inception in 2010, PCORI has awarded 10 grants

to nine different EM PIs in seven U.S. departments of EM.[19] While similar data for VA, HRSA,

SAMHSA, BARDA, and DOD funding are not publicly available, these all provide significant funding for emergency care research.

Foundation Funding for Emergency Medicine Research

Foundations provide another important mechanism of research funding for Departments of EM. Outside the specialty, examples include the American Heart Association (AHA), the Wallace H. Coulter Foundation, the American Geriatrics Society, the American Federation for Aging Research, the John A. Hartford Foundation, and the Robert Wood Johnson Foundation. Within the specialty of EM, the major research funding foundations include the Emergency Medicine Foundation (EMF) and the Society for Academic Emergency Medicine (SAEM) Foundation. Figure 3 illustrates the annual research funding provided by these two foundations since their inception. The National Foundation of Emergency Medicine (NFEM) also provides career development awards. While not at the level of federal funding, this support is essential for early career investigators to gain the research experience and training needed to be competitive for federal funding

2030 Emergency Medicine Strategic Goals for NIH Funding

The purpose of setting 2030 strategic goals for EM NIH funding is to openly and publicly set forth an ambitious, yet realistic, trajectory for achieving the research mission of the specialty. Using available historical data through 2020, the authors used linear regression to establish targets for 2030, based on the goal of sustaining the historic growth rate over the next decade (Supplemental Figure 4). These strategic goals are summarized in Figure 4.

These goals have been endorsed by the AACEM Executive Committee and the Boards of SAEM, ACEP and AACEM. While working to achieve these growth targets, it will be important to invest in diversity and inclusion of the scientific workforce within the specialty. We know from

Jagsi et al. that women and URiM from all specialties tend to lag behind their counterparts in the

total amount of funding and time it takes to become successfully funded.[20,21] The COVID-19

pandemic may exacerbate these differences disproportionately.[22] The activities and influence of

the Academy for Women in Academic Emergency Medicine (AWAEM) and The Academy for

Diversity and Inclusion in Emergency Medicine (ADIEM) will undoubtedly influence this

trajectory.

Strategies to Achieve 2030 Strategic Goals

Increasing the number of EM faculty prepared to submit competitive applications for NIH funding

is fundamental to achieving these goals. This can be achieved by recruiting, training, and

developing more scientists within academic departments of EM and by increasing the number of

academic departments of EM participating in the research enterprise. Undoubtedly this requires

departmental monies and resources, necessitating a multi-pronged national and institutional

approach. A coordinated national effort by EM societies, foundations, and departments is

needed to recruit a diverse group of scientists to the specialty and to leverage existing funding

mechanisms for research training as well as advocate for new ones. The endorsement of this

document by key stakeholder organizations demonstrates the feasibility of our specialty

embracing a common set of goals. However, accountability will also be required if the goals are

to be achieved. Perhaps the greatest responsibility falls upon the department chairs at

academic medical centers that currently support or are capable of supporting federally-funded

research programs. These are the individuals who set and model the departments' culture and

have access to resources needed to support a research enterprise.   However, department

chairs seeking to initiate or grow a research enterprise should also be supported by a national

infrastructure to leverage the expertise and resources to maximize success. AACEM, SAEM,

ACEP, and AAEM can support this mission by promoting scientists and scientific discovery at

the same level as our clinical and education missions. EMF and the SAEM Foundation can expand the impact of their research career development programs by leveraging or partnering with existing federally-funded research training programs. EM departments with established federally-funded research programs should assist EM departments trying to build a federally-funded research program, perhaps through structured consulting facilitated by AACEM. Finally, at the individual level, research-oriented EM residents, fellows, and faculty need to commit to the training, mentorship, and time required to become an independent NIH-funded investigator. Specific strategies that national organizations, departments and individuals can adopt are outlined in more detail in Table below.

Conclusions

The specialty of EM has the obligation to improve the health of the public and patient outcomes by creating knowledge and adopting evidence-based practices in emergency care. However, success will require a coordinated effort, led primarily by chairs of academic departments of EM, with support from a more robust national EM research infrastructure. This effort should aim to create a sustainable pipeline of diverse and well-trained scientists capable of successfully obtaining federal research funding to develop, test and implement innovative diagnostic, monitoring, treatment and prevention strategies focused on emergency care. Creating and supporting a set of common goals to be achieved over the next decade is the first step in this journey.

Table. Proposed Strategies to Achieve the 2030 Emergency Medicine Strategic Goals for

NIH Funding

National Level: Goal - Increase number of federally-funded EM PIs and the number of EM departments with federally-funded PIs	
Strategy	Recommended Approach to *Implementation*
Create a dashboard	**AACEM** creates a public facing dashboard to monitor progress toward these 2030 NIH funding goals
Hold a national consensus conference	**SAEM** holds a national consensus conference focused on creating and sustaining a pipeline of diverse federally-funded emergency medicine scientists.
Create a First K Supplement	**EMF and SAEM Foundation** provide supplemental funding for departments of EM with their first individual NIH K grant to facilitate successful transition to an independent NIH R grant.
Advocate for a NIH-Funded National K12 Program	The **ACEP-SAEM Federal Research Funding Workgroup** works with the Director of the Office of Emergency Care Research and stakeholder NIH Institutes to advocate for a NIH-Funded National K12 program for Emergency Care Research to identify and prepare the most outstanding junior faculty candidates nationally for sustained training as scholars in EM research. This could be modeled after the NICHD-funded Pediatric Critical Care and Trauma Scientist Development Program.[23]
Advertise existing research training programs	The **SAEM Research Committee** develops and maintains an online resource that includes all extramurally funded institutional research training programs to which EM candidates can apply.
Create a Research Program Development Consult Service	**AACEM** creates a formal consulting service through which Chairs and Associate/Vice Chairs for Research from established research programs can provide formal consultation to interested Chairs and Associate/Vice Chairs for Research regarding necessary resources for initiating or expanding a federally funded research enterprise.
Develop a national EM research curriculum	**AACEM and SAEM** partner to develop online webinars and small classroom curriculum for investigators at all levels to standardize outstanding research training. This should specifically include strategies to enhance the diversity of individuals in the research training pipeline.
Create research collaboration networks	**AACEM, SAEM, ACEP, and AAEM** create a national infrastructure to support inter-institutional research collaborations.

Promote EM scientists	**AACEM, SAEM, ACEP, and AAEM** highlight EM scientists and accomplishments in national and regional newsletters and conferences, and in social media platforms. These efforts should be intentional about promoting diversity among EM scientists.
Promote DEI	**AWAEM and ADIEM** work with department chairs to ensure a diverse scientific workforce.

Departmental Level: Goal - Increase number of federally-funded faculty	
Strategy	Recommended Approach to *Implementation*
Engage research-oriented medical students in EM research	**EM faculty investigators** actively engage medical students and Medical Scientist Training Program (MSTP) students in EM research and serve as role models for careers as an EM physician-scientist.
Expand innovative opportunities for combined residency/research training	**EM Residency Program Directors** adopt and adapt combined residency/research programs that include formal research training, mentorship and opportunities for pilot studies, with the goal of becoming independent investigators. Resident applicants rank programs through the common EM match. The Yale Emergency Medicine Scholars (YES) Program and The Iowa Physician Scientist Training Pathway foster early career research development and integrate residency training, clinical fellowship, and postdoctoral research training in a 5-year program. The Stimulating Access to Research in Residency (StARR) (R38) in one NIH-funding mechanism that can support such programs.
Integrate research training into ACGME and non-ACGME fellowships	**EM Fellowship Program Directors** offer pathways to formal research training that include master's or doctoral degrees. Established programs should apply for NIH T32 grants to support post-doctoral research training. Less established programs should leverage existing institutional NIH-funded T32 and KL2 training programs to support research training within existing EM fellowships.
Recruit clinical trainees with formal research degrees	**EM Residency and Fellowship Program Directors** recruit more trainees with MD-PhDs. Recruiting clinical trainees with formal research training will establish a pipeline of potential faculty scientists.
Recruit faculty with formal research degrees	**EM Department Chairs** recruit faculty with formal research degrees. This requires developing mechanisms to support research effort from clinical revenue, hospital contributions from shared services agreements, Chair packages, and/or Dean's designated funds. Appropriate salaries and incentives should be provided. Non-clinical PhD faculty should be well-integrated into the mission of EM and the department.

Develop research collaborations with other departments and schools at your own institution or nationally	**EM Department Chairs and Assoc/Vice Chairs for Research** promote EM research to Deans, other Dept. Chairs and other institutional leaders including interdisciplinary research programs and institutional training programs that include the broad scope of emergency care.
	EM Department Chairs and Assoc/Vice Chairs for Research establish close collaborations with local CTSA programs that have their own KL2 programs that EM research candidates can access.
	EM Department Chairs and Assoc/Vice Chairs for Research create recruitment packages with other departments with shared visions and projects.
	EM Department Chairs and Assoc/Vice Chairs for Research Identify other schools such as Engineering, Public Health, Management that may join EM as core faculty and/or contribute intellectual content, funds or resources to assist with recruitments, career development or grant applications.
Create necessary infrastructure	**EM Department Chairs and Assoc/Vice Chairs for Research** create or gain access to the infrastructure needed to support a federally-funded research program including pre- and post-award administrative staff and wet and dry lab space.
Create a departmental culture that values research and researchers	**EM Department Chairs and Assoc/Vice Chairs for Research, Fellowship Directors, and Residency Program Directors** create a departmental culture that supports the physician scientist career path as viable, respected, and essential to the specialty. Adequate amounts and duration of support should be provided to ensure success.

Individual Level - Goal: Obtain independent federal funding	
Strategy	Recommended Approach to *Implementation*
Obtain Formal Research Training	**EM research trainees and faculty** obtain formal research training that leads to master's or doctoral degrees.
Engage Mentors	**EM research trainees and faculty** engage local, regional and/or national EM and non-EM mentors. Team mentorship is ideal, and trainees should be assisted in developing these mentorship teams. Developing EM researchers access and nurture their own networks from organizational meetings, both EM and content based. Set short- and long-term goals and objectives with specific timelines for projects, accomplishments.
Apply for training slots on existing institutional training grants	**EM research trainees and faculty** apply for institutional T32, KL2, and K12 post-doctoral and early career faculty research training slots that are accessible to EM fellows and faculty at their home institution. These are typically awarded through an internal competitive process.

Apply for individual career development grants	**EM research trainees and faculty** apply for individual career development grants available through foundations and professional organizations [eg, EMF, SAEM Foundation, NFEM, AHA, American Academy of Pediatrics (AAP), and American Pediatric Association (APA)], and the NIH (K08 and K23).
Apply for diversity supplements	Funded EM PIs apply for intramural or extramural diversity supplements. For example, Research Supplements to Promote Diversity are available to NIH-funded PIs of grants with any activity code except individual training grants.
Develop network of investigators with similar interests	**EM research trainees and faculty** seek out and develop collaborations with faculty in other departments and schools..
Maintain a diversified funding portfolio	**EM research trainees and faculty** apply to a broad, diverse group of federal and non-federal funding sources.

FIGURE LEGENDS

Figure 1: Benchmarking by Clinical Specialty

A. The percent of full-time faculty members that are NIH-funded PIs in each clinical specialty was calculated using the number of NIH-funded PIs in each specialty in 2019 reported from Blue Ridge Institute for Medical Research (BRIMR)[24] as the numerator and the number of full-time medical school faculty members in each specialty in 2019 reported by the Association of American Medical Colleges (AAMC).[25] B. The percent of U.S. medical schools with respective clinical departments that have NIH-funded principal investigators in those departments was calculated using the number of medical schools with NIH funding in a clinical specialty in 2019 as reported from the BRIMR[24] as the numerator and the number of U.S. medical school departments in each specialty in 2019 reported by the AAMC[26] as the denominator. C. The percent of full-time faculty members that have MD-PhD degrees in each specialty is calculated using the number of MD-PhD full time medical school faculty in each clinical specialty in 2019 as reported by the AAMC[25] as the numerator and the total number of full-time medical school faculty in each specialty in 2019 as reported by the AAMC[25] as the denominator. D. The percent of full-time faculty members that have PhD or other doctoral degrees without an MD degree in each specialty is calculated using the number of PhD or other doctoral degree full time medical school faculty in each clinical specialty in 2019 as reported by the AAMC[25] as the numerator and the total number of full-time medical school faculty in each specialty in 2019 as reported by the AAMC[25] as the denominator.

Figure 2 Annual NIH Funding to Departments of Emergency Medicine

A. NIH funding to departments of emergency medicine by fiscal year as reported by the BRIMR.[24] B. NIH funded emergency medicine PIs and emergency medicine departments with NIH-funded PIs by fiscal year as reported by the BRIMR.[24] C. Active NIH career development

and training grants in departments of emergency medicine based by fiscal year based on NIH Reporter.[27]

Figure 3. Annual EMF and SAEM Foundation Funding

A. Emergency Medicine Foundation funding since inception based on total dollars awarded and number of grants awarded in each year.[28] B. Society for Academic Emergency Medicine Foundation funding since inception base on total dollars awarded and number of grants awarded in each year.[29]

Figure 4. 2030 Emergency Medicine Strategic Goals for NIH Funding

2030 EM strategic goals for NIH funding are based on sustaining historic growth rates over the past 12-15 years (See supplemental figure 4).

Supplemental Figure 1. Correlation of MD-PhD and PhD (without MD) Faculty with NIH-Funded PIs

A. The correlation of MD-PhD faculty with NIH-funded PIs was performed using linear regression based on the number of full-time medical school MD-PhD Faculty in 2019 in each clinical specialty as reported by the AAMC[25] and the number of NIH-funded PIs in each clinical specialty as reported by the BRIMR.[24] B. The correlation of PhD or other doctoral degree (without MD Degree) faculty with NIH-funded PIs was performed using linear regression based on the number of full time medical school faculty with a PhD or other doctoral degree (without a MD) in 2019 in each clinical specialty as reported by the AAMC[25] and the number of NIH-funded PIs in each clinical specialty as reported by the BRIMR.[24] *This correlation excluded Psychiatry and PM&R due to the significant number of clinical faculty that hold PhD or other doctoral degree (without a MD).

Supplemental Figure 2. Correlation of Percent NIH Funded PIs with Annual NIH Grant Applications per 100 Faculty. The correlation of percent NIH-funded PIs with annual NIH grant applications/100 faculty/year within specific specialties was performed using the linear regression (Microsoft Excel Data Analysis Tool). The percent of NIH-funded PIs for four specialties was calculated by dividing the number of NIH-funded PIs in 2018 based on BRIBR[24] by the number for full time medical school faculty members in each specialty in 2018 based on the AAMC.[25] The average number of annual NIH grant submission from the same four specialties between 2015 and 2018 was calculated based on data published by Brown 2021.[30]

Supplemental Figure 3. Annual AHRQ and CDC Funding to Departments of Emergency Medicine. A. Annual AHRQ funding to departments of EM as reported by NIH Reporter.[27] B. Annual CDC funding to departments of EM as reported by NIH Reporter.[27]

Supplemental Figure 4. Projections for Emergency Medicine NIH funding

A. Projections for annual NIH funded projects with EM PIs were calculated based on a linear regression equation derived from historic values from 2006 to 2020 as reported by NIH Reporter.[27] Projections for total annual NIH funding to EM departments were calculated based on a linear regression equation derived from historic values from 2006 to 2020 as reported by BRIMR.[24] B. Projections for NIH funded EM PIs were calculated based on a linear regression equation derived from historic values from 2009 to 2020 as reported BRIMR.[24] Projections for EM departments with NIH funded PIs were calculated based on a linear regression equation derived from historic values from 2006 to 2020 as reported BRIMR.[24] Linear regression equations were calculated using Microsoft Excel Data Analysis Tool.

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29.   SAEM Foundation. Direct communication with permission.

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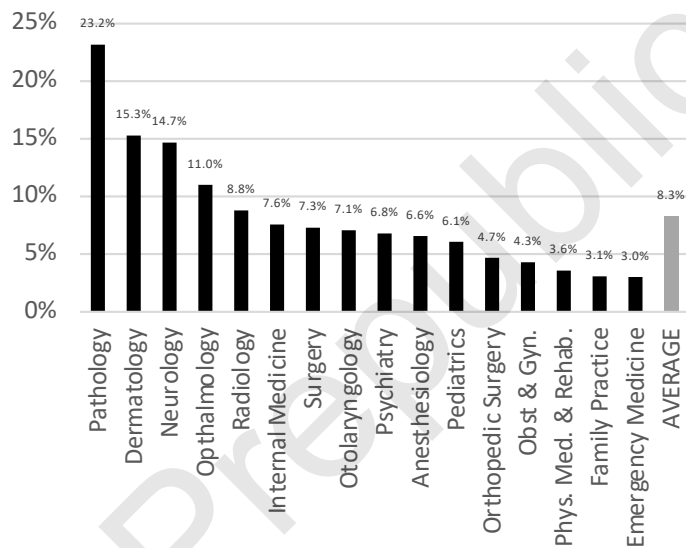# Figure 1. Benchmarking by Clinical Specialty

A. Percent of Full-Time Faculty Members that are NIH-Funded PIs
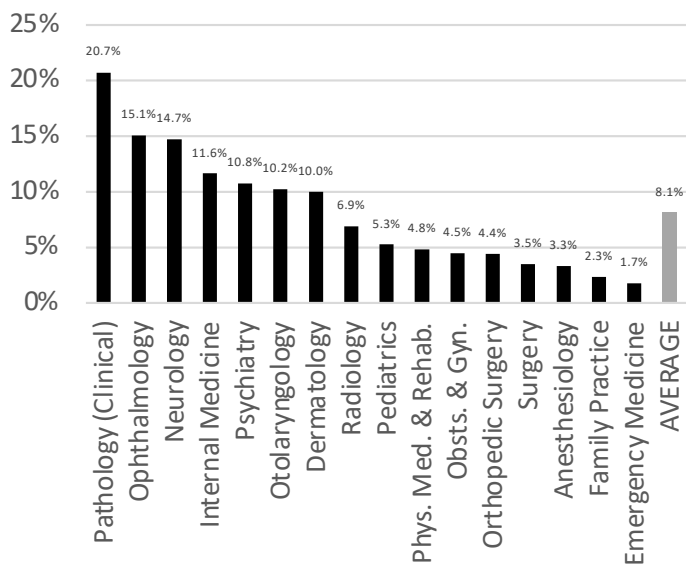
B. Percent of U.S. Medical Schools with Respective Clinical Departments that have NIH-Funded PIs in those Departments
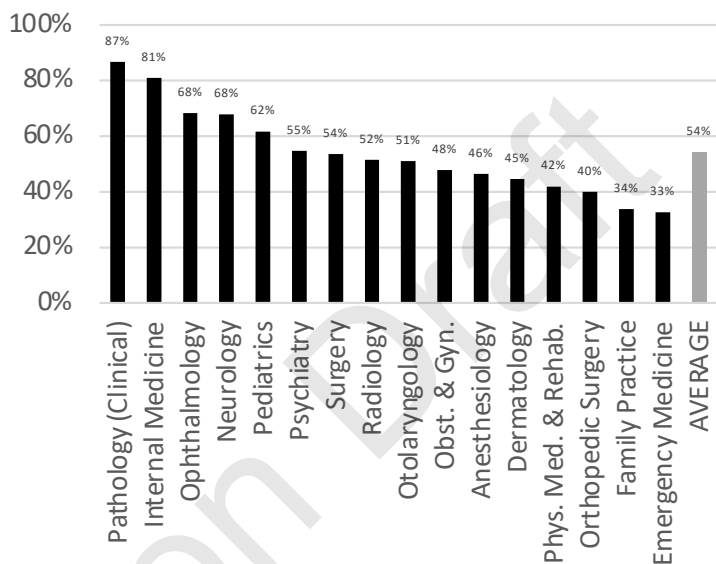
C. Percent of Full-Time Faculty Members that have MD-PhD Degrees

D. Percent of Full-Time Faculty Members that have PhD or other Doctoral Degree (without MD)
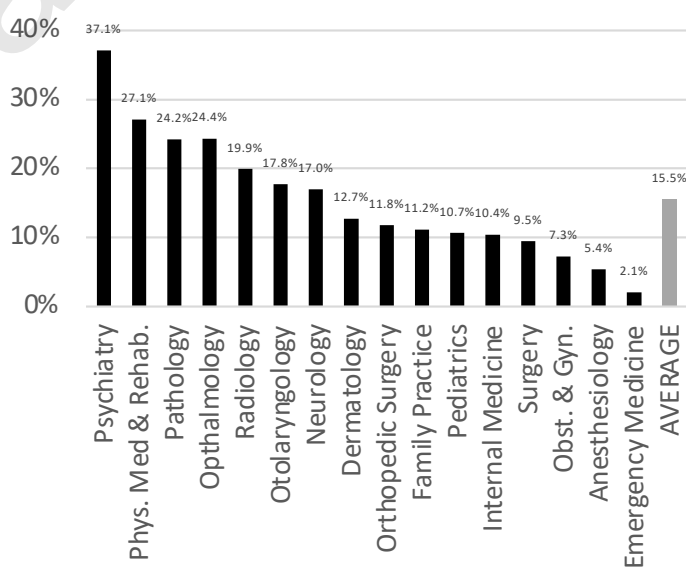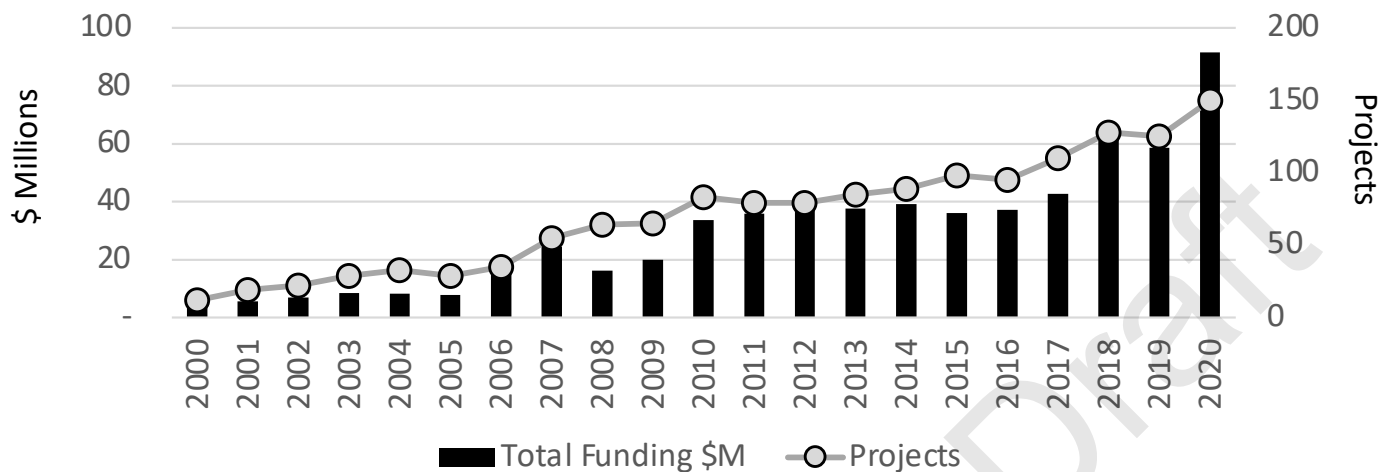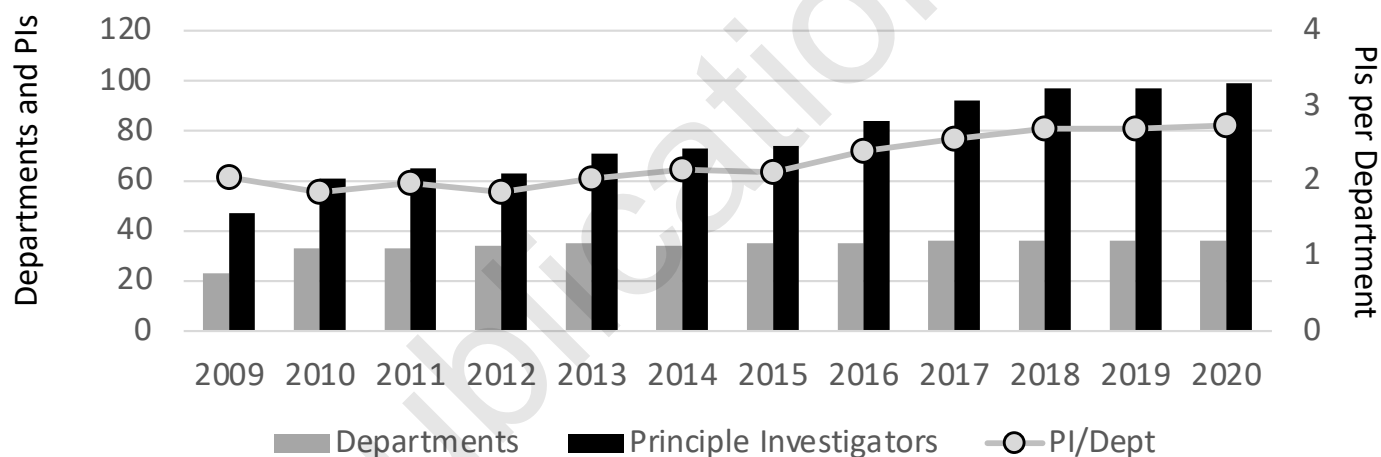
Figure 2. Annual NIH Funding to Departments of Emergency Medicine

A. NIH Funding to Departments of Emergency Medicine

B. NIH-Funded Emergency Medicine PIs and Emergency Medicine Departments with NIH-Funded PIs

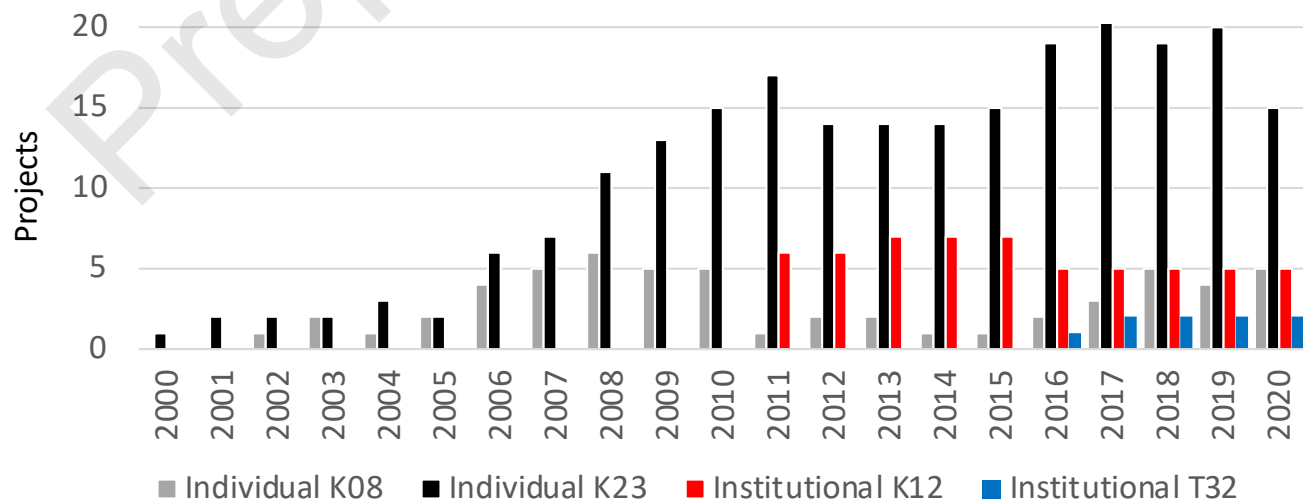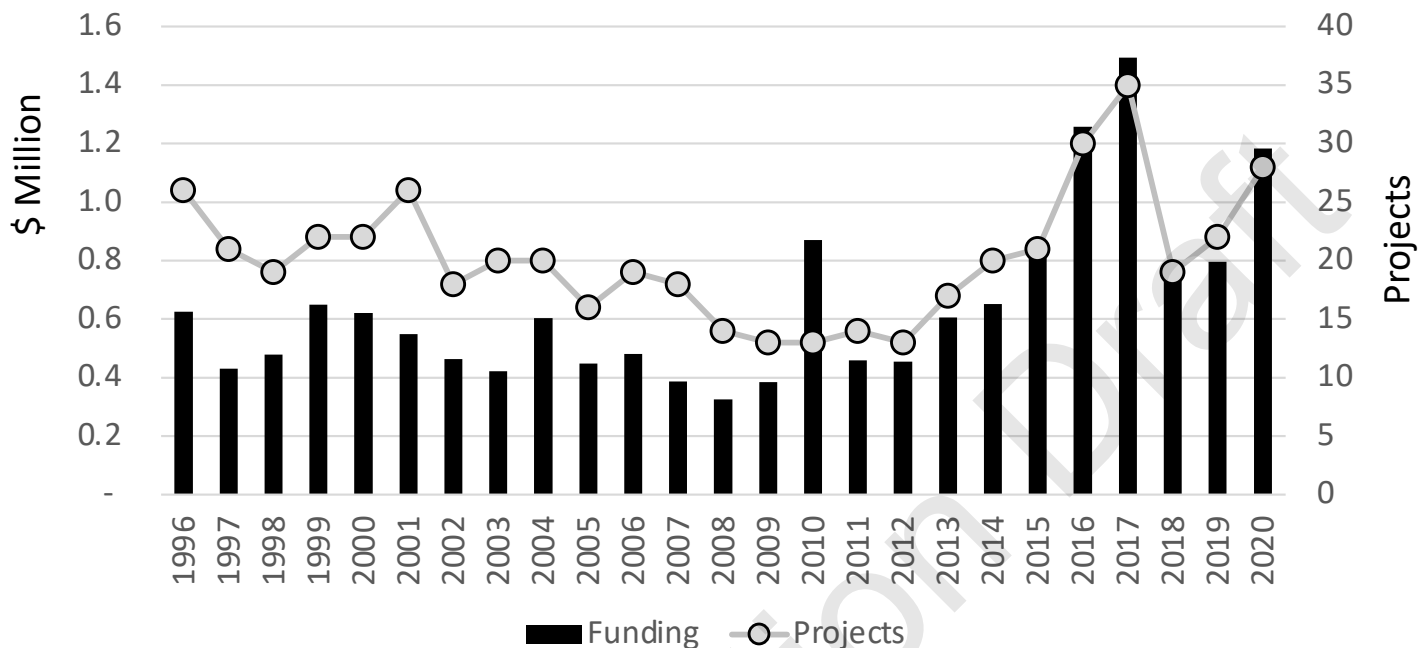**C.** Emergency Medicine NIH Career Development and Training Grants

Figure 3. Annual EMF and SAEM Foundation Funding

A. Emergency Medicine Foundation Funding

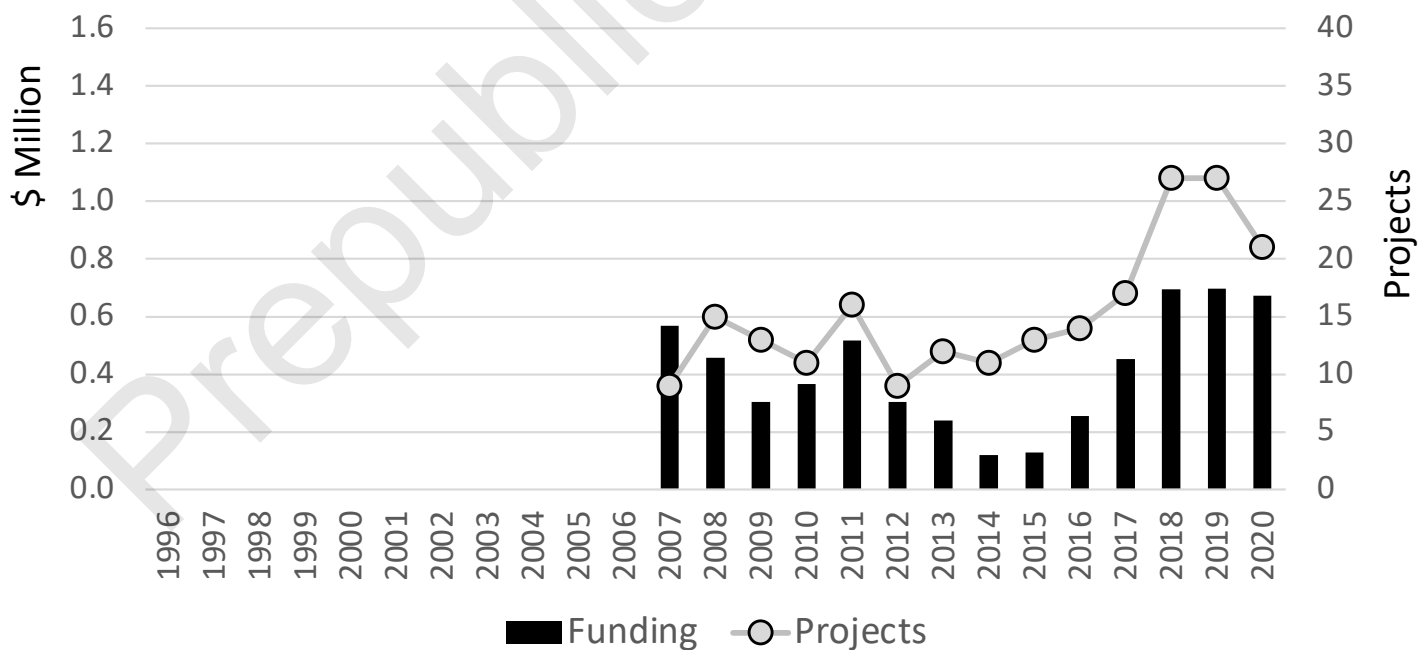B. Society for Academic Emergency Medicine Foundation Funding

Figure 4. 2030 Strategic Goals for Emergency Medicine NIH Funding

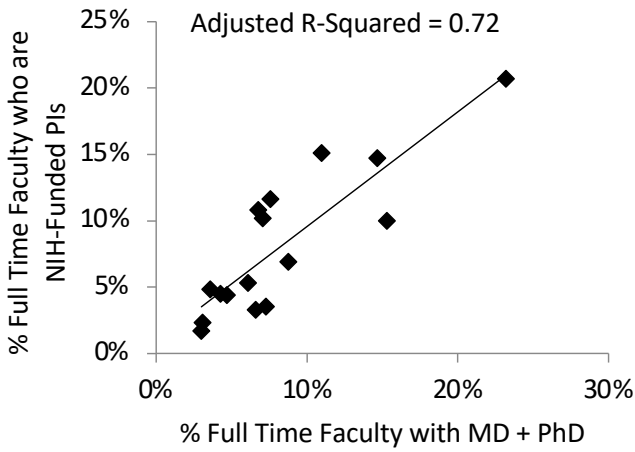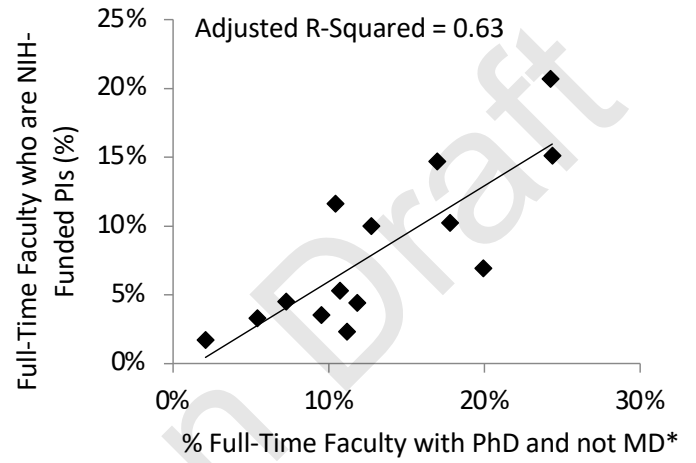| **200**	**$100 M**	**150**	**50**	**3%**
Active NIH Projects	Annual NIH Funding	NIH PIs (25% K)	Departments with NIH-Funded PIs	of EM Medical School Faculty NIH PIs

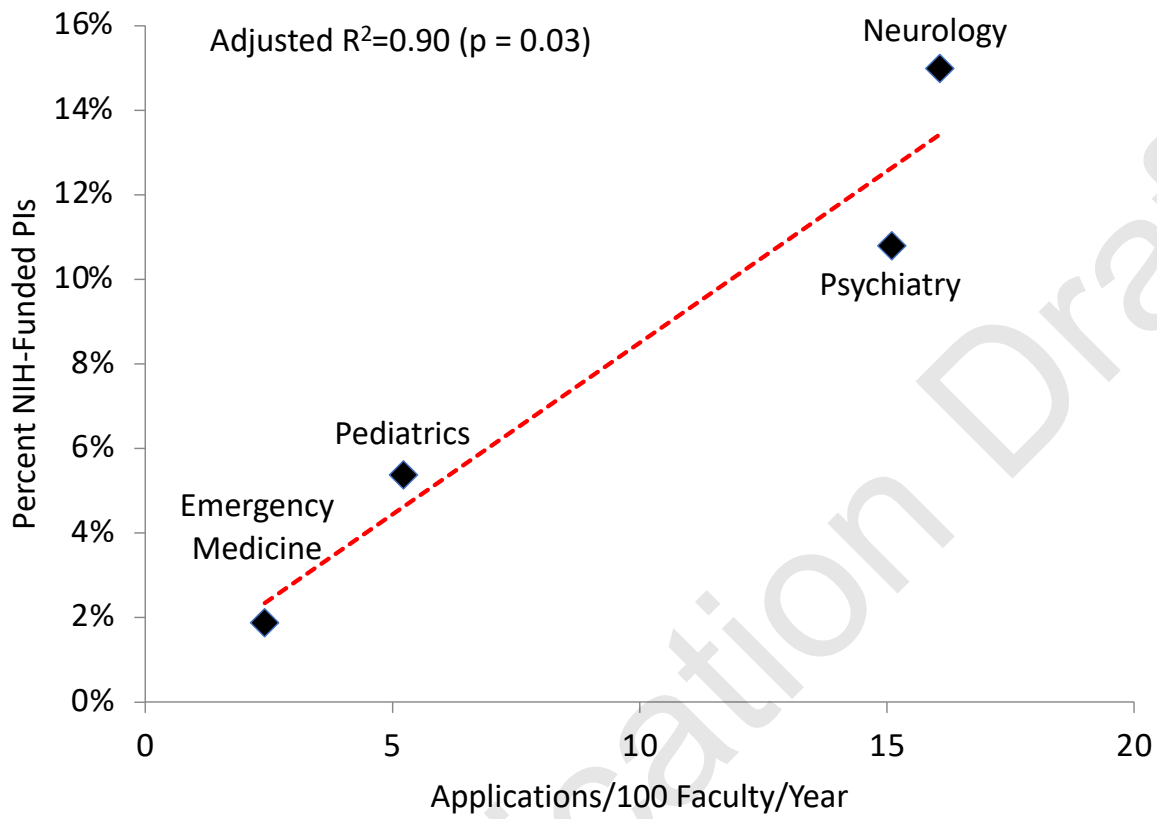**Supplemental Figure 1.** Correlation of MD-PhD and PhD (without MD) Faculty with NIH Funded PIs

A. Correlation of MD-PhD Faculty with NIH Funded PIs

B. Correlation of PhD or other Doctoral Degree (without MD) Faculty with NIH Funded PIs


Adjusted R-Squared = 0.72

% Full Time Faculty who are NIH-Funded PIs

% Full Time Faculty with MD + PhD

Adjusted R-Squared = 0.63

Full-Time Faculty who are NIH-Funded PIs (%)

% Full-Time Faculty with PhD and not MD*

Supplemental Figure 2. Correlation of percent NIH funded PIs with the number of NIH grant applications/100 Faculty/Year

Adjusted R^2=0.90 (p = 0.03)

Y-axis: Percent NIH-Funded PIs (0% to 16%)

X-axis: Applications/100 Faculty/Year (0 to 20)

Data points labeled: Neurology, Psychiatry, Pediatrics, Emergency Medicine
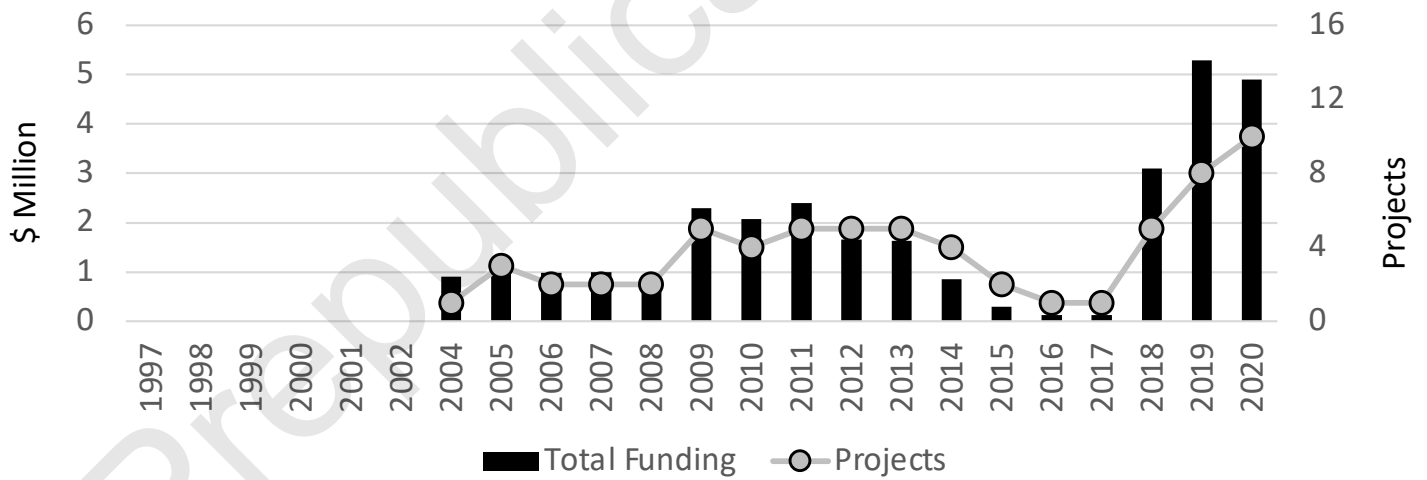
Supplemental Figure 3. Annual AHRQ and CDC Funding to Departments of Emergency Medicine
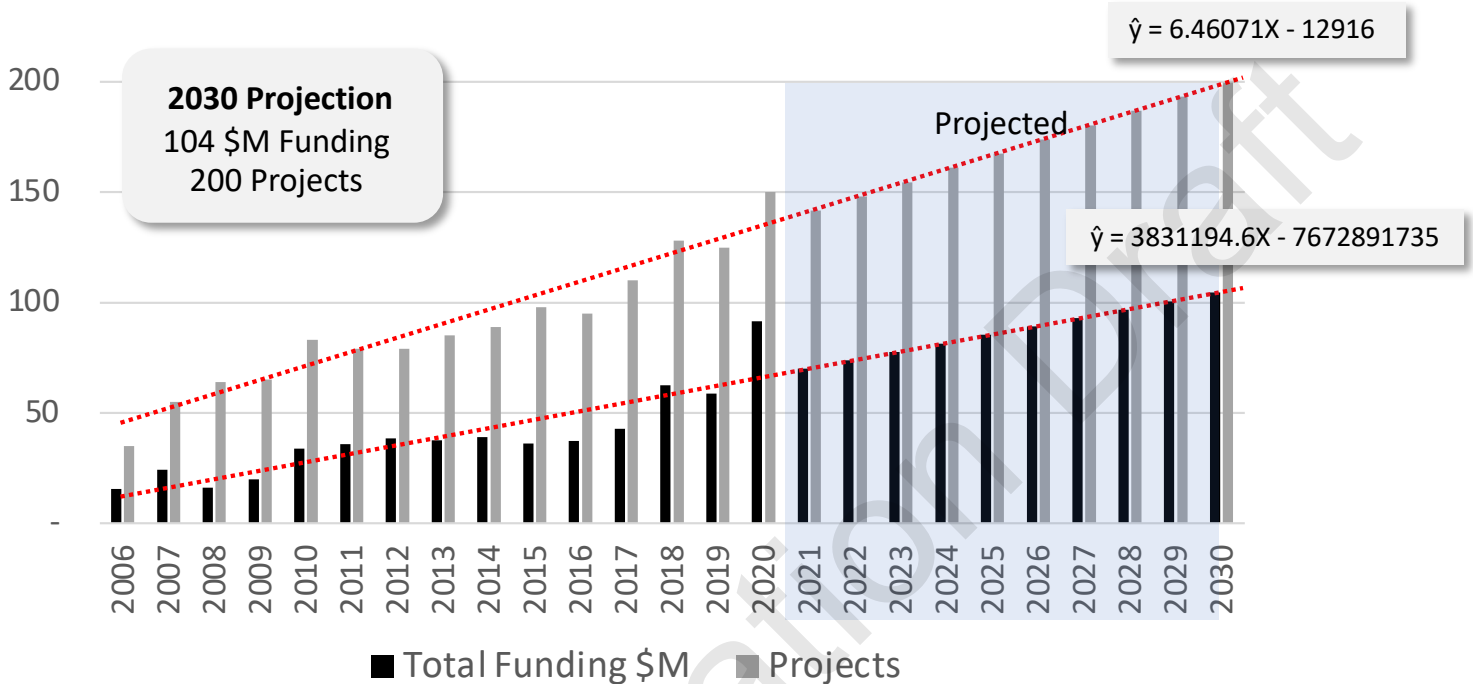
A. AHRQ Funding to Departments of Emergency Medicine
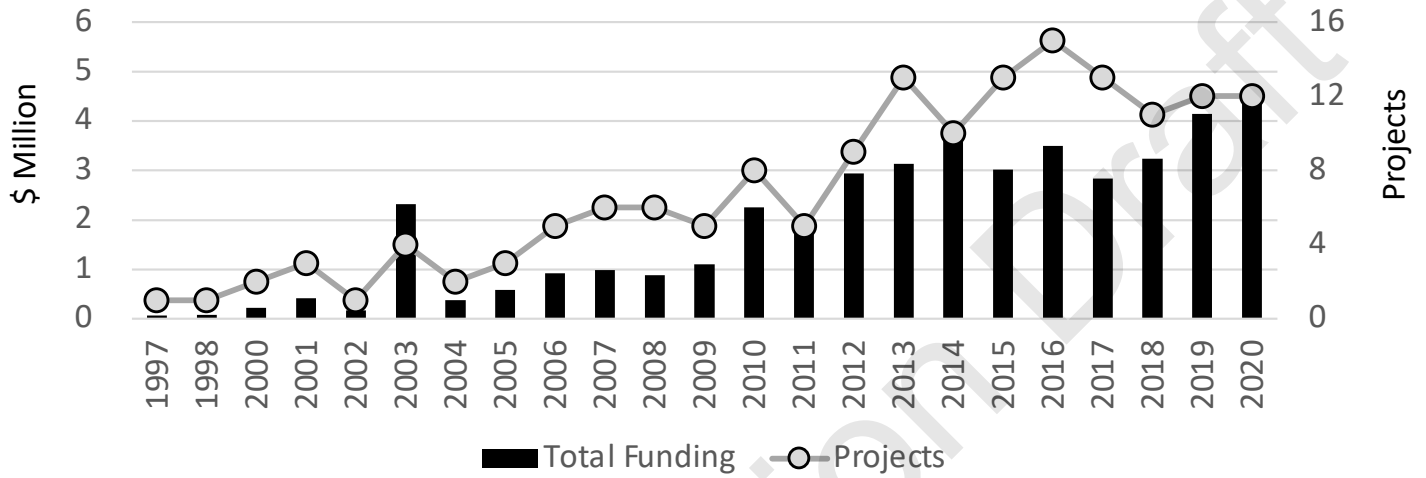
B. CDC Funding to Departments of Emergency Medicine

Supplemental Figure 4. Projections for Emergency Medicine NIH funding

A. Projections for NIH-Funded Projects and Total Funding to EM Departments

$\hat{y} = 6.46071X - 12916$

2030 Projection
104 $M Funding
200 Projects

Projected

$\hat{y} = 3831194.6X - 7672891735$

■ Total Funding $M   ■ Projects

B. Projections for NIH-funded EM PIs and EM Departments with NIH-funded PIs

$\hat{y} = 4.56294X - 9115$

2030 Projection
148 PIs
52 Depts

Projected

$\hat{y} = 1.225X - 2435$

■ Departments   ■ Principle Investigators