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Review Article

Graduate medical education funding mechanisms, challenges, and solutions: A narrative review

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ABSTRACT

Background: With increased attention on the federal budget deficit, graduate medical education (GME) funding has in particular been targeted as a potential source of cost reduction. Reduced GME funding can further deteriorate the compensation of physicians during their residency training.

Methods: In order to understand the GME funding mechanisms and current challenges, as well as the value of the work accomplished by residents, we searched peer-reviewed, English language studies published between 2000 and 2019.

Results: Direct and indirect GME funding is intended to support resident reimbursement and the higher costs associated with supporting a teaching program. However, policy efforts have aimed to reduce federal funding for GME. Furthermore, evidence suggests that residents are inadequately compensated because their salaries do not reflect the number of hours worked and are not comparable to those of other medical staff.

Conclusions: Our review suggests that creative solutions are needed to diversify GME funding and improve resident compensation.

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Introduction

With increased attention on the federal budget deficit, national efforts have been made to minimize spending. Graduate Medical Education (GME) funding, with over \$15 billion annual investment from federal and state entities, has in particular been targeted as a potential source of cost reduction, despite representing 0.55% of the annual health care expenditure.^{1,2} This review aims to describe the current sources of GME funding, current challenges and solutions, the cost of training a resident, and an evaluate resident indebtedness.

Methods

A diverse team of authors, including general surgery resident, attending surgeon, and residency program director, conducted a narrative review of the literature on GME funding mechanisms, current challenges, and solutions. We also reviewed the literature

surrounding factors that determine the value of the work accomplished by surgery residents. We conducted a non-systematic search for peer-reviewed, English language studies published between 2000 and 2019. Reference lists of articles were reviewed to identify additional studies. The entire team of authors identified key findings in the literature related to the GME funding, and the final results are the key points presented in this review. According to the VA Boston Healthcare System policy, our study was exempt from Institutional Board Review.

Results

Sources of graduate medical education (GME) funding

1940s–1970s: The move from apprenticeship to formal residency programs

Before World War II, residency was an apprenticeship. Residents received room, board, clothing and a small stipend financed through hospital charges. Interns received a stipend of \$0–10/month and residents received \$10–50/month.^{3–5} The GI bill marked the beginning of governmental subsidies for teaching hospitals. Stipends were increased and residency positions increased by six fold during 1940–1960, with increased insurance

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charges covering the increasing costs of technology, facilities, and educational expenses.³ The Social Security Amendments of 1965 created the Medicare program, which endeavored to provide support for new physicians until “the community undertakes to bear such education costs in some other way”.^{6,7} This funding was provided through cost-based reimbursement determined by the hospital’s historical and reasonable costs and was expected to cover resident stipends, faculty salaries, and other educational expenses with no determined limits.⁴

1980s–1990s: The creation of IME and DME

The early 1980s saw increased regulation and oversight of federal dollars paying for GME. The Accreditation Council for Graduate Medical Education (ACGME) was created in 1981, which assured the quality of resident education through its resident review committees. In the 1980s, two congressional actions led to the separate mechanisms of indirect graduate medical education (IME) payments and direct graduate medical education (DME) payments.⁸ This change occurred with the implementation of diagnosis-related groups (DRGs) in the early 1980s.¹ DME continued to cover direct costs and was calculated as the average number of full-time equivalent (FTE) positions multiplied by the per resident amount multiplied by the hospital percentage of Medicare inpatient days (Fig. 1). The 1985 Consolidated Omnibus Budget Reconciliation Act (COBRA) set the per resident amount and limited DME reimbursement to residents in their initial residency period or 5 years, whichever was shorter. Subsequent subspecialty training only counted as 0.5 FTE.⁴ IME was created with the understanding that teaching hospitals incur greater costs as compared to non-teaching hospitals due to increased testing, specialized infrastructure for patients and research, and a more complex patient mix. IME is calculated with a curvilinear formula that includes the ratio of interns/residents to beds and a national cost multiplier set by Medicare legislation.³

Growing concerns about skyrocketing national healthcare costs led increased attention to federal GME funding. At that time, if a hospital were to add a resident, it would receive additional Medicare funding to support that resident. Additionally, the amount of per resident reimbursement through DME varied drastically between hospitals – in 1995 it ranged from \$10,000 to \$240,000 per

resident with a median value of \$65,000.³ The Balanced Budget Act of 1997 established a “cap” on the number of residents eligible for Medicare GME reimbursement based on the hospital’s reported resident FTE in 1996.⁴ This act was supported by six major medical organizations in the setting of a shared understanding that the United States was predicted to have a severe oversupply of physicians.⁶ To address the wide variation between the per resident amount used to calculate DME, the Balanced Budget Refinement Act of 1999 established a floor and ceiling for the per resident amount, which was 70% and 140% of the national average per resident amount, respectively.

2000s-present day: Call for reform

With national efforts at deficit reduction and new evidence that the United States is facing a physician shortage rather than a surplus, GME funding reform has been targeted for reform by medical societies and governmental agencies. In 2006, the American Association of Medical Colleges (AAMC) reversed its position regarding physician oversupply, and recommended increasing medical student enrollment by 30%.⁶ The AAMC cited the failure of tightly organized managed-care plans becoming the primary delivery model of US healthcare as the cause of this change in opinion. Efforts to reduce the federal costs of GME funding continued with the bipartisan 2010 Simpson Bowles commission report, which recommended a 50% reduction in IME funding over a 10-year period and capping DME payments at 120% the 2010 national average.¹ This commission followed a 2010 Medicare Payment Advisory Commission (MedPAC) report stating that only 40–45% of IME payments were attributable to higher patient care costs of Medicare patients. In response, the ACGME surveyed designated institutional officials and estimated that these changes would cause 28% of all GME programs to close.⁹

In efforts to reduce federal contributions to GME and reform convoluted reimbursement schemes, the National Academy of Medicine (NAM, previously the Institute of Medicine, IOM) commissioned a study to review GME funding. In their 2014 report, the NAM recommended maintaining aggregate Medicare IME/DME funding, but instead distributing the monies into two subsidiary funds – an Operational Fund for support of current residency training positions and a Transformation Fund for innovation

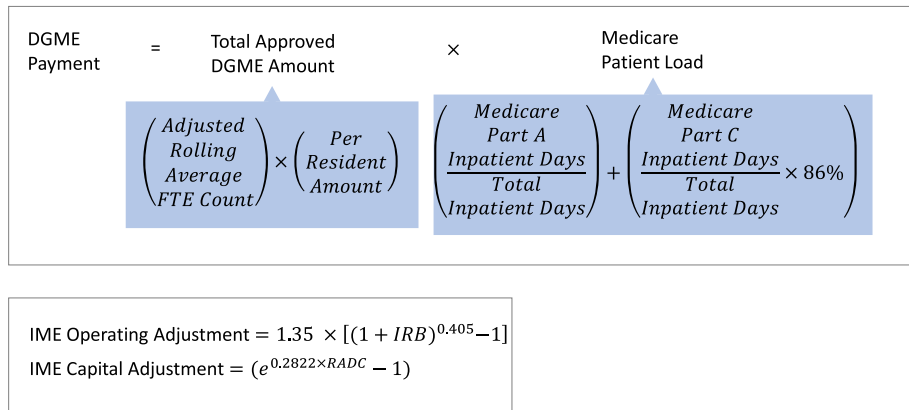


Fig. 1. Direct and Indirect graduate medical education payment formulas. IME payments are adjustments to the operating and capital portions of the Medicare inpatient prospective payment system (IPPS) per-discharge payment. Adjusted rolling average FTE count, IRB, and RADC are subject to Medicare GME cap. GME – Graduate Medical Education. DME – Direct Graduate Medical Education. IME – Indirect Graduate Medical Education. FTE – Full Time Equivalent. IRB = intern and resident-to-bed ratio. RADC = resident-to-average daily census ratio.

through piloting alternative GME payment methods and funding new GME positions in “priority disciplines and geographic areas”.¹⁰ This was met with criticism by the Alliance for Academic Internal Medicine (AAIM) and the American College of Physicians (ACP), who asserted that the report did not recognize the impending physician shortage. The AAIM and ACP published a joint position paper recommending lifting GME caps, spreading the cost of GME among all payers, combining DME and IME, and increasing GME funding transparency.¹¹

GME funding reform was prioritized in President Trump’s Department of Health and Human Services Fiscal Year (FY) 2021 Budget proposal, stating “current graduate medical education funding is outdated, overly broad, and not sustainable long term due to its fragmented nature across multiple funding streams and lack of transparency and accountability.”¹² Since FY 2019, the federal HHS budget has proposed to consolidate federal GME funding from Medicare, Medicaid, and the Children’s Hospital GME (CHGME) program into one grant program that distributes payments to hospitals based on the number of residents and Medicare and Medicaid inpatient days. This grant program will be managed jointly by the Centers for Medicare & Medicaid Services (CMS) and the Health Resources and Services Administration (HRSA). These changes aim to save \$48.1 billion over 10 years.¹³ In the FY 2021 budget, legislative proposals aim to reduce GME payments to FY 2017 levels of Medicare, Medicaid, and Children’s Hospital GME program spending, with adjustments for inflation and plans for growth at 1% below inflation, as measured by the Consumer Price Index for all Urban Consumers (CPI-U) (Fig. 2).

Non medicare contributions to GME

In 2013, Medicare provided \$3.4 billion for DME and \$7.9 billion for IME. Medicaid was the second largest source of GME funding, with an estimated \$5.58 billion contribution in 2018.¹⁴ This amount represented a 50% increase since 2009.

Four additional funding streams for GME include the Department of Veterans Affairs (VA), the HRSA, the Department of Defense (DoD), and private healthcare insurers. The VA, under affiliation agreements, pays for the salary, benefits and a portion of the indirect costs of trainees rotating at their facilities. The HRSA funds 3 federal programs that support residents – the CHGME payment program supporting pediatric residents, the Affordable Care Act’s Teaching Health Center GME program that supports primary care residents, and the Title VII Health Professions program that is directed at primary care residents in hopes that they ultimately practice in healthcare shortage areas. The DoD supports GME programs through the Army, Navy, and Air Force. It is estimated that the DoD supported 1816 FTE residents in 2015.⁴ It is difficult to estimate the amount of support that private insurers contribute GME through contracts with teaching hospitals (Fig. 3).

GME financing challenges and possible solutions

As discussed previously, the NAM and AAIM/ACP have released proposals for GME funding reform. This section discusses two of the most prominent issues with GME funding and proposed solutions (Table 1).

Geographic and specialty maldistribution

In its 2019 report, the AAMC continued to project a physician shortage, estimating a shortfall of 46,900 to 121,900 physicians by 2032.¹⁵ This estimate comprised 21,100 to 55,200 primary care physicians (PCP) and 14,300 to 23,400 specialty surgeons. The wide range in estimated PCP shortfall represents the unknown impact of the projected rapid growth in supply of advanced practice registered nurses (APRN) and physician assistants (PAs). Maldistribution of physicians has been well described in the primary care as well as surgical specialties.^{16,17} The uneven geographic distribution of general surgeons has been found to be mirrored by the regional

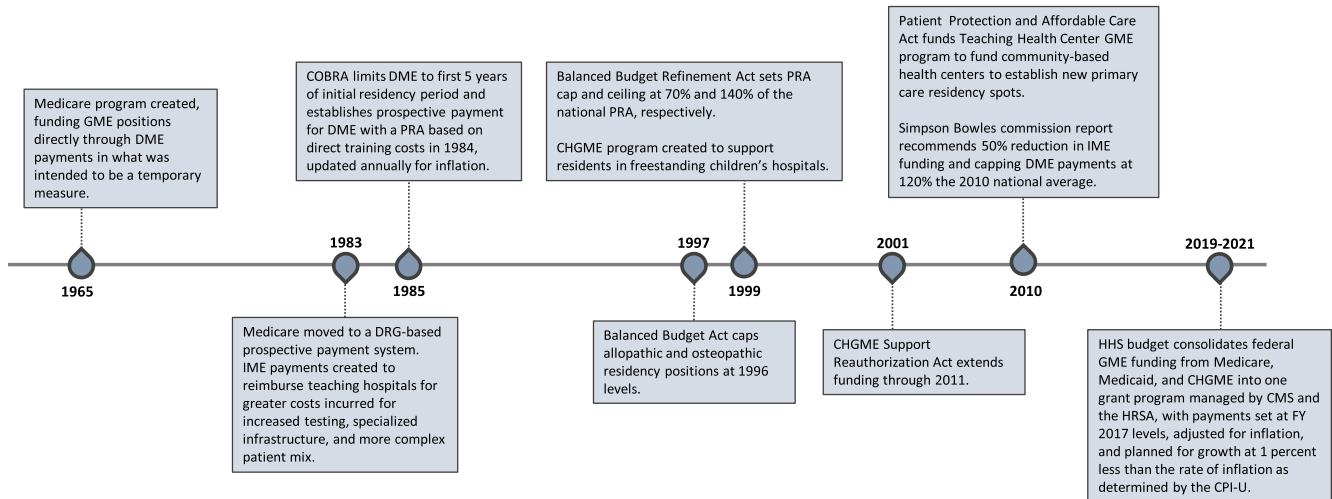


Fig. 2. Timeline of policy milestones in Graduate Medical Education financing.

GME – Graduate Medical Education.

DME – Direct Graduate Medical Education.

DRG – Diagnosis Related Group.

IME – Indirect Graduate Medical Education.

PRA – Per Resident Amount.

CHGME – Children’s Hospital Graduate Medical Education.

HHS – Department of Health and Human Services.

CMS – Centers for Medicare & Medicaid Services.

HRSA – Health Resources and Services Administration.

FY – Fiscal Year.

CPI-U – Consumer Price Index for all Urban Consumers.

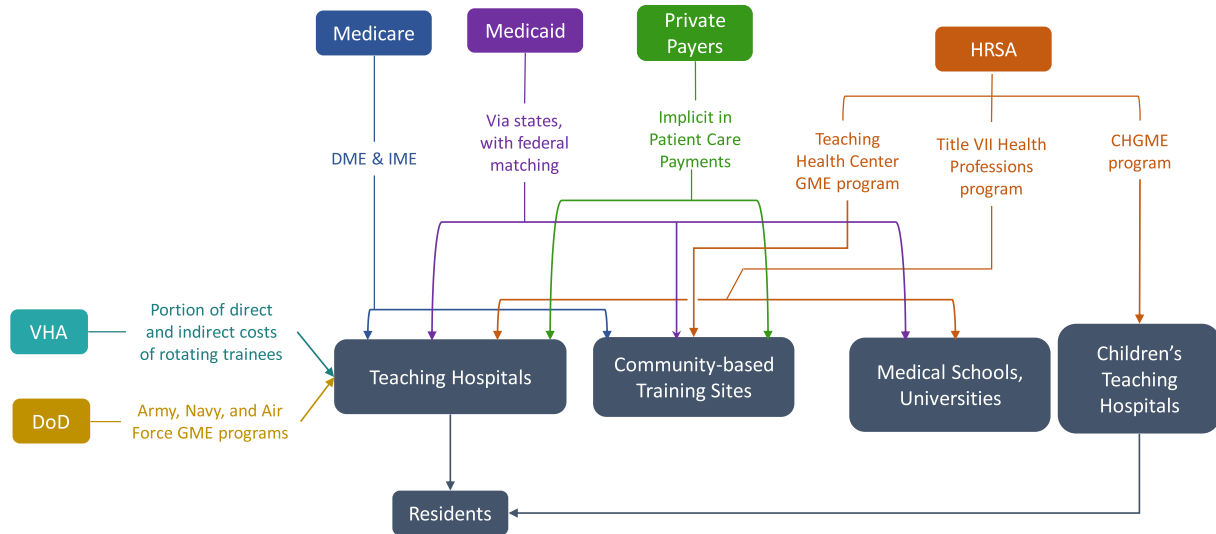


Fig. 3. Graduate medical education funding mechanisms.

GME – Graduate Medical Education.
 DME – Direct Graduate Medical Education.
 IME – Indirect Graduate Medical Education.
 CHGME – Children’s Hospital Graduate Medical Education.
 HRSA – Health Resources and Services Administration.
 VHA – Veterans Health Administration.
 DoD – Department of Defense.

Not depicted are teaching physicians, who receive salary support from DME, private payer payments, teaching hospitals, community-based training sites, and medical schools, and contribute faculty revenue to teaching hospitals, community-based training sites, and medical schools.

distribution of categorical general surgery PGY1 positions.¹⁷ Additionally, the Medicare per resident amount exhibits striking state level variation with payments ranging from \$63,000-\$155,000 per person in Louisiana and Connecticut, respectively (Fig. 4).¹⁸ This state level variation cannot be fully explained by payment formulas and characteristics of each state’s health system. Historically, the development of GME in the first half of the 20th century occurred in the northeast. Expansion of federally funding residency positions was subsequently frozen by the 1997 Medicare GME cap.¹⁸ Subsequent westward and southward expansion resulted patient

population growth that was not accompanied by increased federal subsidies for GME positions.

The National Academy of Medicine (NAM) proposal for GME funding reform addresses the issue of physician maldistribution by recommending establishing a new GME policy and financing infrastructure within the Office of the Secretary of the U.S. Department of Health and Human Services (HHS). This group would research and develop policies regarding the sufficiency, geographic distribution, and specialty configuration of the physician workforce. The NAM report recommended that GME remain

Table 1
 Graduate medical education funding challenges and solutions.

Challenge	Proposed solutions
Geographic and specialty maldistribution	<ul style="list-style-type: none"> Establishing new GME policy and financing infrastructure within the Department of Health and Human Services (NAM)¹⁰ Transition DME/IME into two funds – the “Operational Fund” to distribute per resident payments, the “Transformational Fund” to award training positions in priority geographic areas and specialties (NAM)¹⁰ Support additional research through the National Health Care Workforce Commission on supply, specialty mix, and distribution of physicians (AAIM, ACP)¹¹ Allow for funding for additional trainees in key shortage areas such as primary care and geriatrics (AAIM, ACP)¹¹
Need to reduce dependence on federal funding for GME financing	<ul style="list-style-type: none"> Lift current caps on number of residency positions eligible for federal funding (AAIM, ACP)¹¹ Require contributions from public and private payers in the health care system to contribute to a financing pool supporting residencies (AAIM, ACP, O’leary 2013)^{11,39} Create an all-payer system for GME and UME with a “tuition-for-service” program to pay medical school tuition for physicians working in underserved areas and specialties (Gold 2015)¹⁹ Bill private insurance for unsupervised minor procedures performed by trainees (Feinstein 2011)²⁰ Competency-based progression through residency to shorten training length (O’leary 2013)³⁹ Creation of performance-based metrics for GME funding (Caverzagie 2018)²¹
Graduating residents lack skills needed for current practice environment (e.g. quality improvement, care coordination)	

NAM = National Academy of Medicine.
 AAIM = Alliance for Academic Internal Medicine.
 ACP = American College of Physicians.
 GME = Graduate Medical Education.
 UME = Undergraduate Medical Education (i.e. medical school).

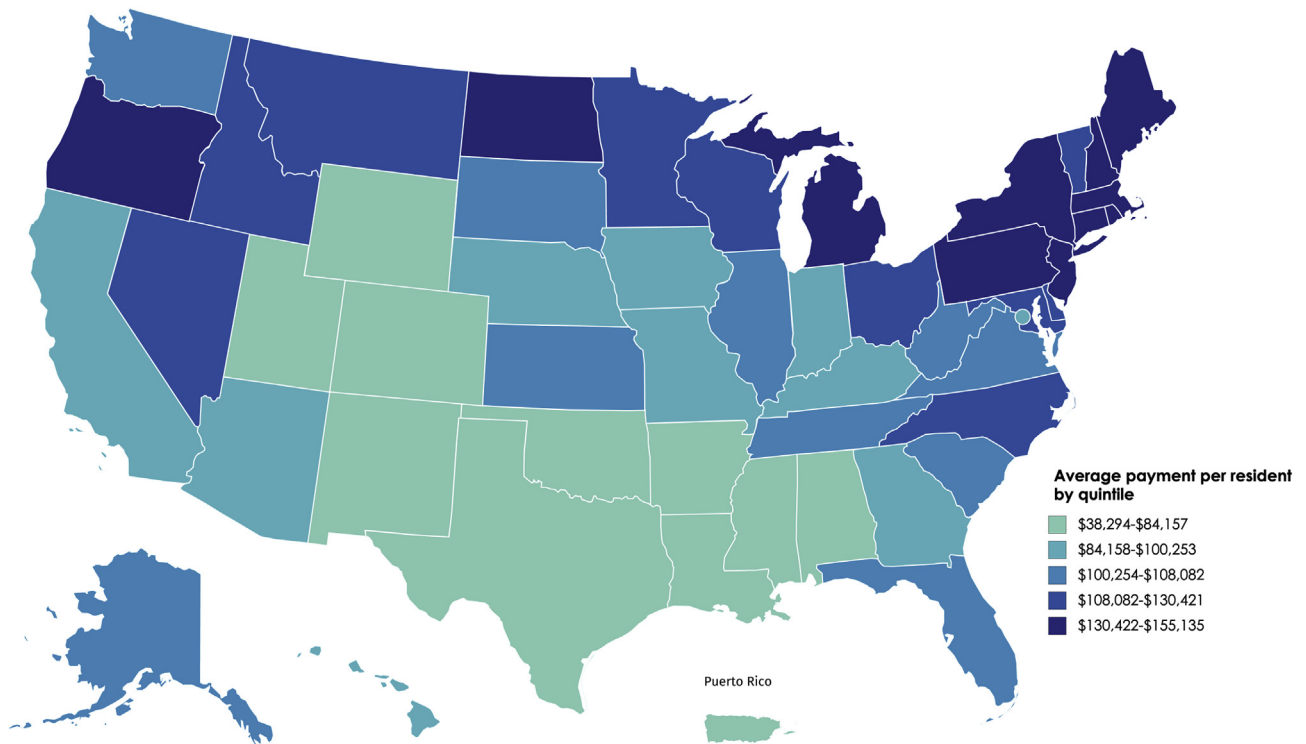


Fig. 4. Graduate Medical Education average per resident payment, 2010. Data from Mullan et al.¹⁸

funded at the previous DME/IME levels but instead be split into two new funds within a separate GME Center within the Centers for Medicare & Medicaid Services – the “Transformation Fund” and the “Operational Fund.” The new GME “Transformation Fund” would finance initiatives that award new Medicare funded GME training positions in priority geographic areas and specialties. The GME Operational fund would continue to distribute per resident amount payments for Medicare-eligible training slots.¹⁰ The AAIM and ACP likewise recommend additional research into the supply, specialty mix, and distribution of physicians, but recommend that this instead be done through the National Health Care Workforce Commission, rather than allocating pre-existing GME funding to creating a new office within HHS. They also call for relaxation of the GME caps on Medicare-funding residency positions to permit training additional physicians in key shortage areas such as primary care and geriatrics.¹¹ The NAM report does comment that the resident cap on Medicare-funded slots contributes to substantial geographic imbalance of GME payments and training slots, but does not advocate for increasing the number of Medicare-funded slots.

Need to find alternative funding sources for GME

When Medicare was created in 1965, the expectation was that it would provide funding for new physicians until the community would be able to fund GME in another way. Currently, Medicare is the largest funder of GME, but policy efforts have aimed to reduce federal funding for GME. The AAIM and ACP report recommend that all payers of the health care system – public and private – should be required to contribute to a financing pool supporting residencies.¹¹ Gold et al. suggested creating an all-payer system for GME and undergraduate medical education (UME) with a “tuition-for-service” program to eliminate medical student debt for those who work in underserved areas and specialties following completion of GME training.¹⁹ Others have proposed billing private insurance for

unsupervised minor procedures performed by trainees.²⁰ Given concerns that current residency graduates are poorly trained in skills needed in the current practice environment such as quality improvement and care coordination, there has been interest in performance-based GME payments on metrics such as value of care, access, and physician wellbeing. The AAIM and ACP remain cautious that these changes should not occur without rigorous research and input from multiple stakeholders, including physicians in training.^{11,21}

Resident Salary and debt

New physicians graduate medical school at a time when their peers in other fields may have already been working and accruing wealth for four years. In contrast, 73% of medical students in 2019 graduated with debt, with a median educational debt of \$200,000. Median 4-year cost of attendance for the Class of 2020 was \$255,517 in public institutions and \$337,583 in private institutions.²² The Medscape 2019 Resident Salary & Debt Report surveyed 2272 US Medscape medical members on income, perceived fairness, and relationships with hospital staff. It estimated the average medical resident makes \$61,200 yearly, with average post graduate year 1 (PGY-1) salary \$55,200.²³ Over 50% of residents did not feel like they were fairly compensated, with over 50% stating they were dissatisfied with compensation because it does not reflect the number of hours worked (86%), is not comparable to that of other medical staff (72%), or does not reflect the required skill level (69%). 44% of surveyed residents felt compensation does not meet the cost of living. Over 60% said they feel they should make at least 25% more in compensation, with 41% of residents stating that potential earnings were extremely or very influential in specialty choice. Interestingly, these data showed more men than women reported that potential earnings have a very strong influence on specialty choice (47% vs. 31%,

respectively).²³ A gender disparity in salary expectations was also found in a recent study by Gray et al. which found that female general surgery residents had lower expectations compared with men in minimum starting salary (\$249,502 vs. \$267,700) and viewed salary negotiation less favorably.²⁴

The cost associated with training a resident

Estimates find the cost of training a resident to be greater than DME funding provided by Medicare. However, studies have demonstrated that if residents are able to bill for their procedures, they can earn a substantial portion of their salary. In 2014, Ben-Ari and colleagues estimated the cost of training an internal medicine resident to be \$181,737 to \$209,999 annually, with higher costs associated with outpatient intensive programs that have a smaller resident-to-faculty ratio.²⁵ A report by the RAND corporation estimated the median DME cost per FTE resident to be \$134,803 yearly.²⁶ General surgery-specific costs have not yet been published, although Lauer's study of 8 surgical GME programs (including general surgery, otolaryngology, ophthalmology, oral-maxillofacial surgery, urology, pediatric dentistry, and vascular surgery) found an average per trainee cost to be \$84,171 per trainee.²⁷ A study of one academic anesthesia program estimated the annual direct cost of their anesthesia residency (salaries and fringe benefits) to be \$1,300,000 and the payments collected to be \$2,802,969, with total direct revenue attributable to anesthesiology residents \$1,500,000.²⁸ An estimation of one orthopedic resident's call shifts found that the value of on-call consults performed (not including first assist duties) was twice the amount of DME funds paid to the hospital and 60% of the amount of combined DME and IME payments.²⁹ And a United Kingdom study found that a general surgery resident clinic generated revenue equal to 95% of a resident's salary.³⁰ A study of surgical resident revenues, if they were compensated at the level of supervised "junior associates," found financial contributions to be \$94,872 annually, more than 75% of direct educational costs.³¹

Unsurprisingly, it has been well documented that involving a surgery resident will increase operative time and cost. A study of 29,134 cases performed at Greenville Memorial Hospital in South Carolina showed that 45 out of 246 procedures took significantly longer with a resident present in the room. Procedure time increased on average by 4.8 min and was estimated to cost \$9.57 per minute.³² This difference was replicated when residents were incorporated into a community hospital where attending surgeons had previously been operating without a resident.³³ Increased operative time was found to be associated with level of experience. In a study of 1063 cases, mastectomies took significantly longer when PGY1-3 residents were involved, but the difference disappeared by PGY4-5.³⁴

Conversely, studies have uniformly found significant costs associated with replacing residents with faculty and advanced practice practitioners (APPs) like Nurse Practitioners (NPs) and physicians assistants (PAs).^{27,35–37} Pisetsky et al. found that replacing an anesthesiology resident with certified registered nurse anesthetists (CRNAs), NPs, and PAs would cost approximately \$153,000 over the 3-year training period.³⁵ A financial value analysis of replacing a 30-position general surgery residency program with APPs would cost \$4.5 million, based on a 1:3 senior staff to APP replacement ratio. Replacement with senior staff would approach \$9 million.³⁶ In the aforementioned study by Lauer et al., replacing surgery residents with APPs or hospitalists would cost the health system an additional \$16,651,281 or \$26,119,281 annually, respectively.²⁷

Discussion

Our findings in this review demonstrate that the history of GME funding is convoluted with the majority of funding stemming from Medicare. Medicare GME funding was established

with the assumption that it would be a temporary funding measure until other sustainable funding streams could be created. However, ongoing concerns about rising national healthcare costs have increased attention to federal GME funding. Currently, hospitals receive Direct and Indirect GME funding that is intended to support per resident reimbursement and the higher costs associated with supporting a teaching program, respectively. Recent calls for reform have been aimed at reducing geographic and specialty maldistribution and distributing the costs of GME through public and private stakeholders.

Our review also highlights the inadequate resident reimbursement for their intense work. At a time when residents graduate with on average \$200,000 educational debt, they expect and deserve better compensation because their salaries do not reflect the number of hours worked and are not comparable to those of other medical staff.

Our findings suggest that GME funding and resident compensation remain interconnected. Some of the strategies proposed to improve both GME funding and resident compensation include creation of an all-payer system for graduate and undergraduate medical education; institution of a "tuition-for-service" program to eliminate medical student debt for those who work in underserved areas and specialties following residency training¹⁹; billing private insurance for unsupervised minor procedures performed by trainees²⁰; and institution of performance-based GME payments on metrics such as value of care, access, and physician wellbeing.^{11,21} Importantly, these changes should not occur without rigorous research and input from multiple stakeholders, including physicians in training. Therefore, future research should address the impact of these proposed interventions and develop other innovative solutions to improve both GME funding and resident compensation.

Our view is that the current GME funding paradigm is unsustainable, and without significant reform in the next 5–10 years, vulnerable GME programs will be forced to close and geographic and specialty maldistribution will continue to exacerbate national health care disparities.^{9,18} Initially, the allotment of GME funds from Medicare was intended as a stopgap measure until a better funding mechanism could be created.⁷ Currently, there is a severe misalignment between the public institutions that fund GME and those that benefit from well-trained physicians, such as private insurance.¹¹ The current funding structure, with the majority of funding through Medicare and Medicaid, does not allow for the innovation necessary to address geographic and specialty maldistribution. Medicare resident caps limit the creation of new GME positions in underserved areas.¹⁸ Additionally, GME funding has been specifically targeted by the current administration as a source of deficit reduction. Restructuring of GME funding has already begun on the federal level to consolidate funding streams and limit future funding growth to 1% less than the rate of inflation.¹² The current coronavirus-2019 pandemic has necessitated a national economic reprioritization of funding with the passing of the \$2 trillion Coronavirus Aid, Relief, and Economic Security (CARES) Act, which will have profound impacts on all levels of governmental funding for healthcare.³⁸ If we do not pursue aggressive GME funding reform, we may fail to provide our nation with well-trained physicians in the specialties that it requires.

Our review has some important limitations. First, we did not conduct a systematic review, and relevant literature may have been excluded. Second, we used an unblinded review process and

consensus to determine inclusion. We attempted to mitigate this limitation by requiring three independent reviews of each article and using both a quantitative and qualitative assessment of each reviewed article. A third limitation of this review is the small number of original studies available in the literature.

These limitations notwithstanding, this review brings awareness to the complex challenges of GME funding and resident compensation. We encourage readers to consider how these findings could be used to promote future research in these critical areas.

Conclusion

We reviewed the literature on the GME funding mechanisms, its challenges, and proposed solutions. Innovative and comprehensive interventions are needed to diversify GME funding and improve resident compensation.

References

1. Ward RC, Mainiero MB. Graduate medical education in the era of health care reform. *J Am Coll Radiol*. 2013;10(9):708–712. <https://doi.org/10.1016/j.jacr.2013.03.004>.
2. Congressional research service. Federal support for graduate medical education: an overview. Published December 27, 2018. Accessed May 29, 2020 <https://fas.org/sgp/crs/misc/R44376.pdf>.
3. Guss D, Prestipino AL, Rubash HE. Graduate medical education funding: a Massachusetts General Hospital case study and review. *J Bone Joint Surg Am*. 2012;94(4):e24. <https://doi.org/10.2106/JBJS.K.00425>.
4. Schuster BL. Funding of graduate medical education in a market-based healthcare system. *Am J Med Sci*. 2017;353(2):119–125. <https://doi.org/10.1016/j.amjms.2016.11.027>.
5. Rich EC, Liebow M, Srinivasan M, et al. Medicare financing of graduate medical education. *J Gen Intern Med*. 2002;17(4):283–292. <https://doi.org/10.1046/j.1525-1497.2002.10804.x>.
6. Iglehart JK. Medicare, graduate medical education, and new policy directions. *N Engl J Med*. 2008;359(6):643–650. <https://doi.org/10.1056/NEJMhpr0803754>.
7. House report number 213, 89th congress, 1st session. <https://www.govinfo.gov/app/details/STATUTE-79>; 1965. Accessed May 29, 2020.
8. Steinmann AF. Threats to graduate medical education funding and the need for a rational approach: a statement from the alliance for academic internal medicine. *Ann Intern Med*. 2011;155(7):461–464. <https://doi.org/10.7326/0003-4819-155-7-201110040-00008>.
9. Nasca TJ, Miller RS, Holt KD. The potential impact of reduction in federal GME funding in the United States: a study of the estimates of designated institutional officials. *J Grad Med Educ*. 2011;3(4):585–590. <https://doi.org/10.4300/JGME-03-04-33>.
10. Committee on the governance and financing of graduate medical education, board on health care services, Institute of medicine. In: Eden J, Berwick D, Wilensky G, eds. *Graduate Medical Education that Meets The Nation's Health Needs*. National Academies Press (US); 2014. <http://www.ncbi.nlm.nih.gov/books/NBK248027/>. Accessed February 4, 2020.
11. Butkus R, Lane S, Steinmann AF, et al. Financing U.S. Graduate medical education: a policy position paper of the alliance for academic internal medicine and the American College of physicians. *Ann Intern Med*. 2016;165(2):134–137. <https://doi.org/10.7326/M15-2917>.
12. Office of Budget (OB) AS for FR (ASFR). FY 2021 budget & performance. HHS.gov. Published October 5, 2019. Accessed May 28 <https://www.hhs.gov/about/budget/index.html>; 2020.
13. Office of Budget (OB) AS for FR (ASFR). FY 2019 budget & performance. HHS.gov. Published March 11, 2019. Accessed May 28 <https://www.hhs.gov/about/budget/fy2019/index.html?language=es>; 2020.
14. Medicaid Graduate Medical Education Payments. Results from the 2018 50-state survey. Accessed May 28 <https://store.aamc.org/mcicaid-graduate-medical-education-payments-results-from-the-2018-50-state-survey.html>; 2020.
15. The 2019 update: the complexities of physician supply and demand: projections from 2017 to 2032. AAMC. Accessed February 12 <https://www.aamc.org/data-reports/workforce/data/2019-update-complexities-physician-supply-and-demand-projections-2017-2032>; 2020.
16. Petterson S, Robert L, Phillips J, Bazemore A, Koinis GT. Unequal distribution of the U.S. Primary care Workforce. *AFP*. 2013;87(11). <https://www.aafp.org/afp/2013/0601/od1.html>. Accessed February 12, 2020.
17. Sirinek KR, Willis R, Stewart RM. Geographic maldistribution of general surgery PGY1 residents: another US surgical desert. *Am J Surg*. 2014;208(6):1023–1028. <https://doi.org/10.1016/j.amjsurg.2014.06.033>. discussion 1027–1028.
18. Mullan F, Chen C, Steinmetz E. The geography of graduate medical education: imbalances signal need for new distribution policies. *Health Aff*. 2013;32(11):1914–1921. <https://doi.org/10.1377/hlthaff.2013.0545>.
19. Gold JP, Stimpson JP, Caverzagie KJ. Envisioning a future governance and funding system for undergraduate and graduate medical education. *Acad Med*. 2015;90(9):1224–1230. <https://doi.org/10.1097/ACM.0000000000000816>.
20. Feinstein AJ, Deckelbaum DL, Madan AK, McKenney MG. Unsupervised procedures by surgical trainees: a windfall for private insurance at the expense of graduate medical education. *J Trauma*. 2011;70(1):136–139. <https://doi.org/10.1097/TA.0b013e3182014caf>. discussion 139–140.
21. Caverzagie KJ, Lane SW, Sharma N, et al. Proposed performance-based metrics for the future funding of graduate medical education: starting the conversation. *Acad Med*. 2018;93(7):1002–1013. <https://doi.org/10.1097/ACM.0000000000002096>.
22. Medical Student Education. Debt, costs, and loan repayment fact card 2019 (PDF). Accessed February 20 <https://store.aamc.org/medical-student-education-debt-costs-and-loan-repayment-fact-card-2019-pdf.html>; 2020.
23. Medscape residents salary & debt report. *Medscape*; 2019. <http://www.medscape.com/slideshow/2019-residents-salary-debt-report-6011735>. Accessed February 20, 2020.
24. Gray K, Neville A, Kaji AH, et al. Career goals, salary expectations, and salary negotiation among male and female general surgery residents. *JAMA Surg*. August 28, 2019 <https://doi.org/10.1001/jamasurg.2019.2879>. Published online.
25. Ben-Ari R, Robbins RJ, Pindiprolu S, Goldman A, Parsons PE. The costs of training internal medicine residents in the United States. *Am J Med*. 2014;127(10):1017–1023. <https://doi.org/10.1016/j.amjmed.2014.06.040>.
26. Wynn BO, Smalley R, Cordasco KM. Does it cost more to train residents or to replace them? *Rand Health Q*. 2013;3(3). <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5051990/>. Accessed February 21, 2020.
27. Lauer CI, Shabahang MM, Restivo B, et al. The value of surgical graduate medical education (GME) programs within an integrated health care system. *J Surg Educ*. 2019;76(6):e173–e181. <https://doi.org/10.1016/j.jsurg.2019.08.006>.
28. Turner BC, Tsai MH, Black IH, Mathews DM, Adams DC. Observations: clinical revenue directly attributable to anesthesiology residents. *J Grad Med Educ*. 2014;6(2):384. <https://doi.org/10.4300/JGME-D-13-00419.1>.
29. Jackson JB, Huntington WP, Frick SL. Assessing the value of work done by an orthopedic resident during call. *J Grad Med Educ*. 2014;6(3):567–570. <https://doi.org/10.4300/JGME-D-13-00370.1>.
30. Fitzgerald JEF, Ravindra P, Lepore M, Armstrong A, Bhangu A, Maxwell-Armstrong CA. Financial impact of surgical training on hospital economics: an income analysis of 1184 out-patient clinic consultations. *Int J Surg*. 2013;11(5):378–382. <https://doi.org/10.1016/j.ijsu.2013.02.017>.
31. Stoller J, Pratt S, Stanek S, Zelenock G, Nazzari M. Financial contribution of residents when billing as “junior associates” in the “surgical firm. *J Surg Educ*. 2016;73(1):85–94. <https://doi.org/10.1016/j.jsurg.2015.06.013>.
32. Allen RW, Pruitt M, Taaffe KM. Effect of resident involvement on operative time and operating room staffing costs. *J Surg Educ*. 2016;73(6):979–985. <https://doi.org/10.1016/j.jsurg.2016.05.014>.
33. Babineau TJ, Becker J, Gibbons G, et al. The “cost” of operative training for surgical residents. *Arch Surg*. 2004;139(4):366–369. <https://doi.org/10.1001/archsurg.139.4.366>. discussion 369–370.
34. Chamberlain RS, Patil S, Minja EJ, Kordears K. Does residents' involvement in mastectomy cases increase operative cost? If so, who should bear the cost? *J Surg Res*. 2012;178(1):18–27. <https://doi.org/10.1016/j.jss.2012.08.027>.
35. Pisetsky MA, Lubarsky DA, Capehart BP, Lineberger CK, Reves JG. Valuing the work performed by anesthesiology residents and the financial impact on teaching hospitals in the United States of a reduced anesthesia residency program size. *Anesth Analg*. 1998;87(2):245–254. <https://doi.org/10.1097/0000539-199808000-00003>.
36. Mrdutt MM, Weber RA, Burke LM, Thomas JS, Papaconstantinou HT, Cable CT. Financial value analysis of surgical residency programs: an argument against replacement. *J Surg Educ*. 2018;75(6):e150–e155. <https://doi.org/10.1016/j.jsurg.2018.07.004>.
37. DeMarco DM, Forster R, Gakis T, Finberg RW. Eliminating residents increases the cost of care. *J Grad Med Educ*. 2017;9(4):514–517. <https://doi.org/10.4300/JGME-D-16-00671.1>.
38. McConnell M. Text - S.3548 - 116th congress (2019-2020): CARES act. Published March 21, 2020. Accessed May 29 <https://www.congress.gov/bills/116th-congress/senate-bill/3548/text>; 2020.
39. O'Leary JP, Hernandez Suarez Y, Valverde EJ, Rock JA. Some musings on the fate of graduate medical education. *J Surg Educ*. 2013;70(3):432–434. <https://doi.org/10.1016/j.jsurg.2013.01.001>.